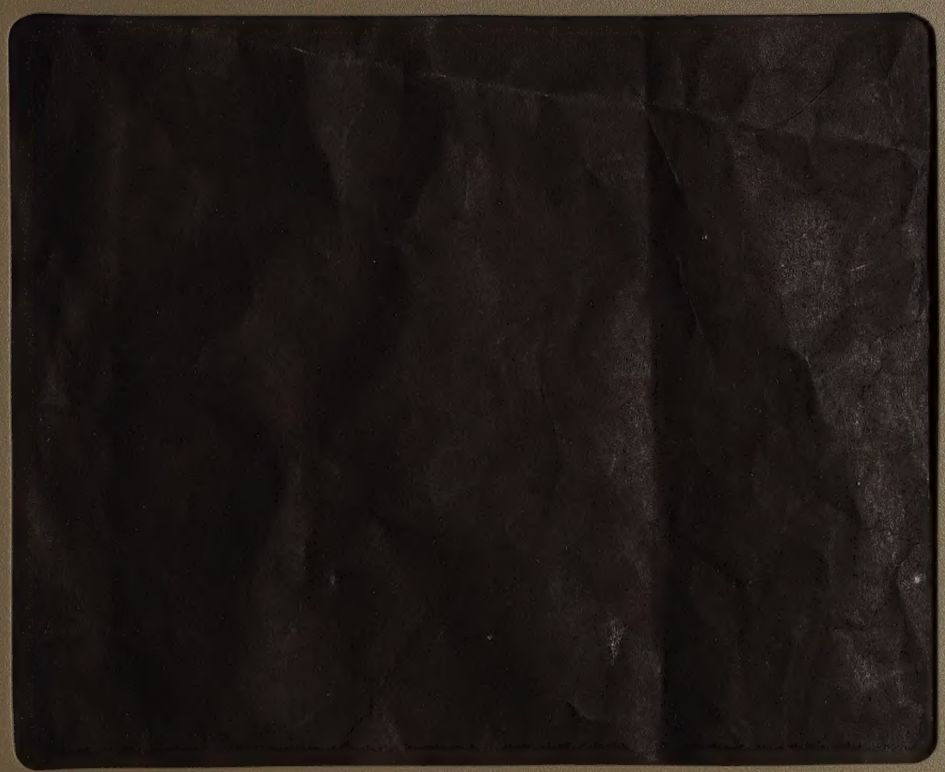
SE LABORATORIES



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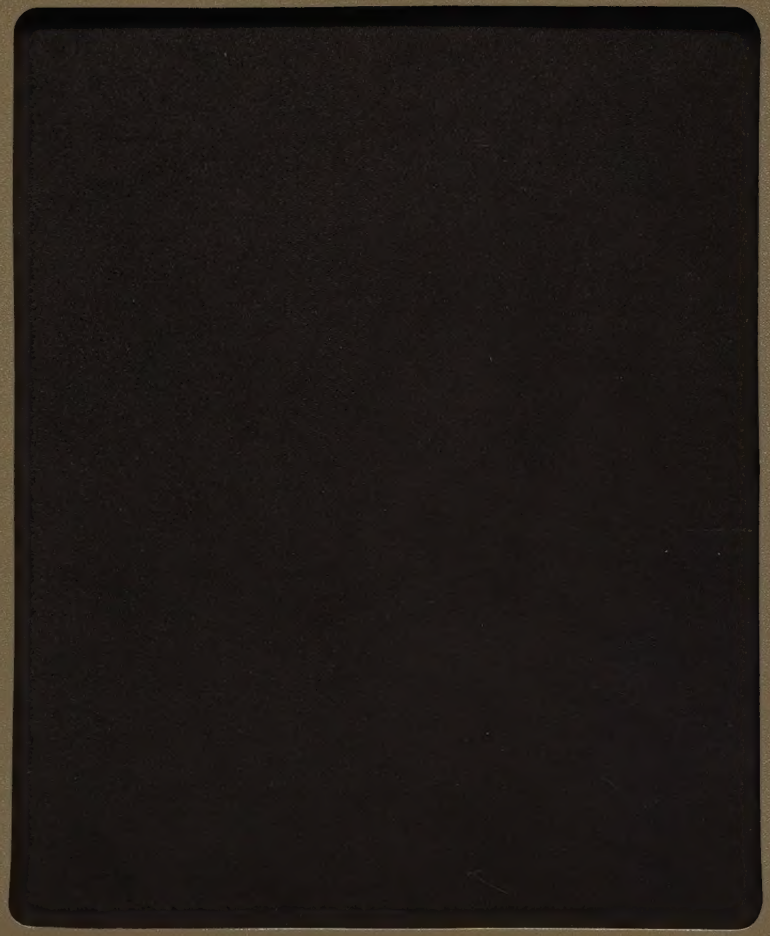

2100A
Digital Thermometer

Instruction Manual

P/N 397075
July 1975
Rev. 1 11/75

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WARRANTY

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2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way"* prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

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Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 2100A is a digital, thermocouple thermometer, employing the dual-slope integration technique, and capable of making precise temperature measurements in either degrees Fahrenheit (°F) or degrees Celsius (°C). The instrument is fully guarded and features a fully isolated input.

1-3. The 2100A has a five-digit readout (plus sign) capable of indicating up to ±3999.9 degrees. However, the range of the instrument is determined by the type of thermocouple used. The instrument can be ordered, configured to use any of the following types: J, K, T, E, R and S. Table 1-1 shows the temperature ranges for each of these types. Resolution of the instrument is 0.1 degree, except in instruments using a type R or a type S thermocouple and indicating in °F, when resolution is 0.2 degrees. The readout features 0.5 inch characters, fixed decimal point, and leading-zero suppression for the two most significant digits.

1-4. The 2100A is available in three basic models: the 2100A–03, the 2100A–06, and the 2100A–10. The 2100A–03 is a single-point instrument (one input); the 2100A–10 is a multi-point instrument (10 inputs). Both of these models are tailored at the factory to use only one specific type of thermocouple. Once tailored, the 2100A–03 and 2100A–10 are limited to that one type, but can be converted to any one of the other five at any time, by means of a conversion kit.

1-5. The 2100A–06 is a multi-type instrument. It is tailored to accept inputs from any of the six different types of thermocouple, but only one type at any given time. (The 2100A–06 is not a multi-point instrument). In effect, the 2100A–06 is a 2100A–03 that can be rapidly converted to accept different thermocouples, by means of integral selector switches, rather than conversion kits. For valid indications from a 2100A–06, the selector switch depressed must correspond to the type of thermocouple being used. In addition, the 2100A–06 can accept linearized voltage inputs on either of two selectable mV ranges directly from other transducers, such as bridge-connected strain gauges. Table 1-2 is a summary of the differences between the three basic models of the 2100A.

Table 1-1. THERMOCOUPLE RANGES

TYPE OF THERMOCOUPLE		RANGE
J	Iron/Constantan (Fe/Cu Ni)	–320°F to +1400°F –200°C to + 760°C
K	Chromel/Alumel (Ni Cr/Ni Al)	–320°F to +2400°F –200°C to +1370°C
T	Copper/Constantan (Cu/Cu Ni)	–320°F to + 750°F –200°C to + 400°C
E	Chromel/Constantan (Ni Cr/Cu Ni)	–320°F to +1830°F –200°C to + 960°C
R	Platinum-13% Rhodium/ Platinum (Pt 13% Rh/Pt)	0°F to +3200°F 0°C to +1760°C
S	Platinum-10% Rhodium/ Platinum (Pt 10% Rh/Pt)	0°F to +3200°F 0°C to +1760°C

Table 1-2. BASIC MODEL SUMMARY

MODEL	DESCRIPTION
2100A–03	Single-Type, Single-Point
2100A–06	Multi-Type, Single-Point
2100A–10	Single-Type, Multi-Point

1-6. Each of the three 2100A models can have their inputs expanded by means of a companion instrument, the Model 2150A. This instrument is also available in three basic models: the 2150A–10, the 2150A–20, and the 2150A–30. These three models expand the thermocouple inputs of the 2100A–03 and 2100A–06 to 10, 20, and 30 points, respectively. In the case of the 2100A–10, the expanded number of points is added to the 10 existing points.

1-7. All three models of the 2100A can be set up to indicate on either the Fahrenheit or the Celsius scale, but not both. The scale employed in any given instrument is determined by a plug-in, stored-program read-only memory (ROM). A different ROM is used for each temperature scale' An instrument can be converted in the field from °F to °C by replacing the °F–ROM with the °C – ROM changing the thermocouple type board for a °C type, and recalibrating the instrument.

1-8. There are three options and a number of conversion kits and accessories available to any of the three basic models. The options and conversion kits are listed in Table 1-3.

1-9. A Rechargeable Battery Pack (Option –01) permits operation of the 2100A at remote locations where ac line power is not available. An instrument equipped with a battery pack is still operable from ac line power. During ac line operation, the battery is recharged.

Table 1-3. OPTIONS AND CONVERSION KITS

NO. (2100A-)	NAME
01	Rechargeable Battery Pack
02	Data Output Unit (DOU)
04	Analog Output Unit (AOU)
––K**	Conversion Kit, New Thermocouple
F2CK	Conversion Kit, °F to °C
10K*	Conversion Kit, Multi-Point†

* The letter K denotes kit.
** Specify new type and desired scale (e.g., 2100A–ECK)
† Converts 2100A–03 into 2100A–10.

1-10. A Digital Output Unit (Option –02) permits the instrument to interface with digital instrumentation (printer, tape punch, computer, etc.). The Digital Output Unit (DOU) has an isolated parallel, 8-4-2-1 weighted, bcd output. The DOU can be updated by an external signal, or be enabled to be continuously updated at the 2100A cycle rate. (Due to internal space limitations, the –01, 02 and 04 options are mutually exclusive.)

1-11. An Analog Output Unit (Option –04) provides an output voltage representative of the temperature displayed on the front panel. The output of the Analog Output Unit (AOU) is equal to one millivolt for each degree of temperature with a one-half degree temperature recognition factor (0.5mV per degree on R and S Fahrenheit scales). This option, when coupled with a strip-chart recorder, provides a graphic illustration of temperature changes occurring over an extended period of time.

1-12. Two of the conversion kits facilitate field conversion to a new type of thermocouple or from the Fahrenheit scale to the Celsius scale. The third kit facilitates field conversion of a 2100A–03 to a 2100A–10.

1-13. The 2100A can be a bench-top instrument or can be rack-mounted or panel-mounted. Two different rack-mounting kits and a panel-mounting kit are among the accessories available. Power input requirements are 100, 115 or 230V ac ±10% at 50 to 440 Hz, or 11.5 to 17.5V dc. Each individual 2100A operates from only one type of ac source. The voltage and frequency of the required ac source is stamped on a decal attached to the instrument.

1-14. SPECIFICATIONS

2100A–03 Digital Thermometer for one type of thermocouple

Types of Thermocouple: J, K, E, T, R, S

Input Circuit: Two wire with guard, isolated

Input Connections: Three screw terminals on isothermal block at rear

Measurement Method: Dual slope integration over 100 ms period with automatic zero

Response Time to Rated Accuracy: < 1.0 second

Reading Rate: 2.5 readings per second fixed

Type of Display: 5 digit 0.55 inch gas discharge

Linearization: Digital with six programs stored in ROM

Number of Segments: 64 segments in each program

Reference Junction Compensation:

J, K, T, E	0.01° per ° over ambient range of 20°C to 30°C (+68°F to 86°F) 0.02°C per ° from 0°C to 20°C and 30°C to 50°C (32°F to 68°F and 86°F to 122°F)
R, S	0.04° per ° over ambient range of 20°C to 30°C (+68°F to 86°F) 0.07° per ° from 0°C to 20°C and 30°C to 50°C (32°F to 68°F and 86°F to 122°F)

Temperature Coefficient: ±(15 ppm ±0.1 uV)/°C

Input Impedance: 1000 MΩ

Input Current: < 200 pA

Maximum Source Impedance: 1.5 kΩ source impedance causes less than 0.1°C error

Overload: Continuous 250V dc or ac rms across input will not cause damage

Common Mode Rejection: 160 dB at 50/60 Hz ±0.1% with 100 Ω in either lead. A common mode voltage of 250V will cause an error of less than 0.1°C using a K couple.

Common Mode Voltage: Maximum of 250V dc or ac rms.

Normal Mode Rejection: 90 dB at 50/60 Hz ±0.1% A normal mode 50/60 Hz voltage of 100 mV will cause an error of < 0.1°C using a type K couple.

Zero Drift: Automatic zero correction.

Open Circuit Detection: A source impedance of greater than 1.5 kΩ ±500Ω or capacitance less than 0.01 uF ±0.005 uF is defined as open circuit. An open circuit input is indicated by blanked digits.

Accuracy: See Table 1-4

Size: 3½" high x 8½" wide x 12:: deep (8.89 cm x 21.59 cm x 30.5 cm).

Weight: 8 pounds (3,63Kg)

Power:

line voltage	nominal	range
standard	115V ac	95-128Vac
optional	100V ac	83-111Vac
optional	230V ac	180-256Vac

External Battery 11.5Vdc to 17.5Vdc - 400 mA drain

Operating Temperature: 0 to +50°C (+32 to +122°F)

Storage Temperature: –40 to +75°C (–40 to +167°F) Line operated
–40 to +60°C (–40 to +140°F) Battery operated

Humidity: 80% non-condensing over operating temperature range. 90% up to 35°C (95°F)

Shock & Vibrations: Meets requirements of MIL–T–21200L and MIL–E–16400F

Table 1-4. OVERALL ACCURACY (Including reference junction and conformity but not including thermocouple).

Type of Couple	Temperature Range	Resolution & Repeatability	Maximum Error: Applicable Temperature Range	Maximum Error: 24 Hrs, 23°C to 27°C or 72°F to 82°F	Maximum Error: 90 Days, 20°C to 30°C, or 68°F to 86°F	Maximum Error: 1 Year, 15°C to 35°C or 59°F to 95°F	NBS Conformity
DEGREES FAHRENHEIT							
J Iron/Constantan	−320°F to +1400°F	0.1°F	−320°F to +190°F +190°F to +1400°F	±0.4°F ±0.45°F	±0.6°F ±0.65°F	±0.8°F ±1.0°F	±0.2°F ±0.15°F
K Nickel Chromium/ Nickel Aluminum	−320°F to +2400°F	0.1°F	−320°F to 0°F 0°F to +1500°F +1500°F to +2400°F	±0.45°F ±0.55°F ±0.6°F	±0.65°F ±0.75°F ±0.8°F	±0.85°F ±1.0°F ±1.2°F	±0.2°F ±0.25°F ±0.15°F
E Nickel Chromium/ Constantan	−320°F to +1830°F	0.1°F	−320°F to +600°F +600°F to +1830°F	±0.45°F ±0.6°F	±0.65°F ±0.8°F	±0.85°F ±1.1°F	±0.2°F ±0.2°F
T Copper/Constantan	−320°F to +750°F	0.1°F	−320°F to 0°F 0°F to +750°F	±0.45°F ±0.35°F	±0.65°F ±0.55°F	±0.85°F ±0.75°F	±0.2°F ±0.15°F
R Platinum 13% Rhodium/Platinum	0°F to +3200°F	0.2°F	0°F to +100°F +100°F to +1600°F +1600°F to +3200°F	±1.2°F ±1.0°F ±1.1°F	±1.5°F ±1.3°F ±1.4°F	±2.0°F ±1.9°F ±2.0°F	±0.7°F ±0.4°F ±0.5°F
S Platinum 10% Rhodium/Platinum	0°F to +3200°F	0.2°F	0°F to +130°F +130°F to +3200°F	±1.2°F ±1.0°F	±1.5°F ±1.3°F	±2.0°F ±1.9°F	±0.65°F ±0.4°F
DEGREES CENTIGRADE							
J Iron/Constantan	−200°C to +760°C	0.1°C	−200°C to −150°C −150°C to +760°C	±0.45°C ±0.35°C	±0.55°C ±0.45°C	±0.7°C ±0.6°C	±0.3°C ±0.2°C
K Nickel Chromium/ Nickel Aluminum	−200°C to +1370°C	0.1°C	−200°C to −150°C −150°C to +150°C +150°C to +1370°C	±0.45°C ±0.35°C ±0.40°C	±0.55°C ±0.45°C ±0.5°C	±0.7°C ±0.6°C ±0.65°C	±0.3°C ±0.2°C ±0.15°C
E Nickel Chromium/ Constantan	−200°C to +960°C	0.1°C	−200°C to −150°C −150°C to 0°C 0°C to +960°C	±0.5°C ±0.45°C ±0.35°C	±0.6°C ±0.55°C ±0.45°C	±0.75°C ±0.7°C ±0.6°C	±0.35°C ±0.3°C ±0.12°C
T Copper/ Constantan	−200°C to +400°C	0.1°C	−200°C to −150°C −150°C to +60°C +60°C to +400°C	±0.4°C ±0.35°C ±0.3°C	±0.5°C ±0.45°C ±0.4°C	±0.65°C ±0.6°C ±0.55°C	±0.25°C ±0.2°C ±0.15°C
R Platinum 13% Rhodium/Platinum	0°C to +1760°C	0.1°C	0°C to +80°C +80°C to +600°C +600°C to +1760°C	±0.75°C ±0.55°C ±0.5°C	±0.95°C ±0.75°C ±0.7°C	±1.3°C ±1.1°C ±1.1°C	±0.45°C ±0.2°C ±0.15°C
S Platinum 10% Rhodium/Platinum	0°C to +1760°C	0.1°C	0°C to +80°C +80°C to +600°C +600°C to +1760°C	±0.65°C ±0.6°C ±0.5°C	±0.85°C ±0.8°C ±0.7°C	±1.2°C ±1.2°C ±1.1°C	±0.35°C ±0.25°C ±0.15°C

2100A–01 - Rechargeable Battery Pack

Type of Cell: Rechargeable Ni Cad, "HALF D"

Configuration: Self-contained within the instrument

Number: 9 cells providing 11 volts

Operating Time: Typically, 7 hours continuous operation

Charge-Discharge Cycles: Minimum of 1000

Additional Weight: 2 pounds (0,91Kg)

2100A–02 - Digital Output Unit

Type of Output: Fully isolated, buffered, parallel bcd.

Available Data: 18 bits data, 8 bits of channel identity, polarity, open circuit, function.

Flags: Busy, not busy

Control Inputs: EXTERNAL TRIGGER. (Negative going edge trigger.)

This allows external control of DOU update.

EXTERNAL TRIGGER ENABLE.

In the "1" state this allows the DOU to be updated by an external trigger. In the "0" state it allows the DOU to be updated at the instrument reading rate of 2½ readings per second.

Data Coding: 1-2-4-8 bcd positive true parallel.

Logic Levles: "1" = +4V, "0" - +0.4V

Drive Capability: All outputs can drive one standard TTL load (i.e., sink 2.1 mA).

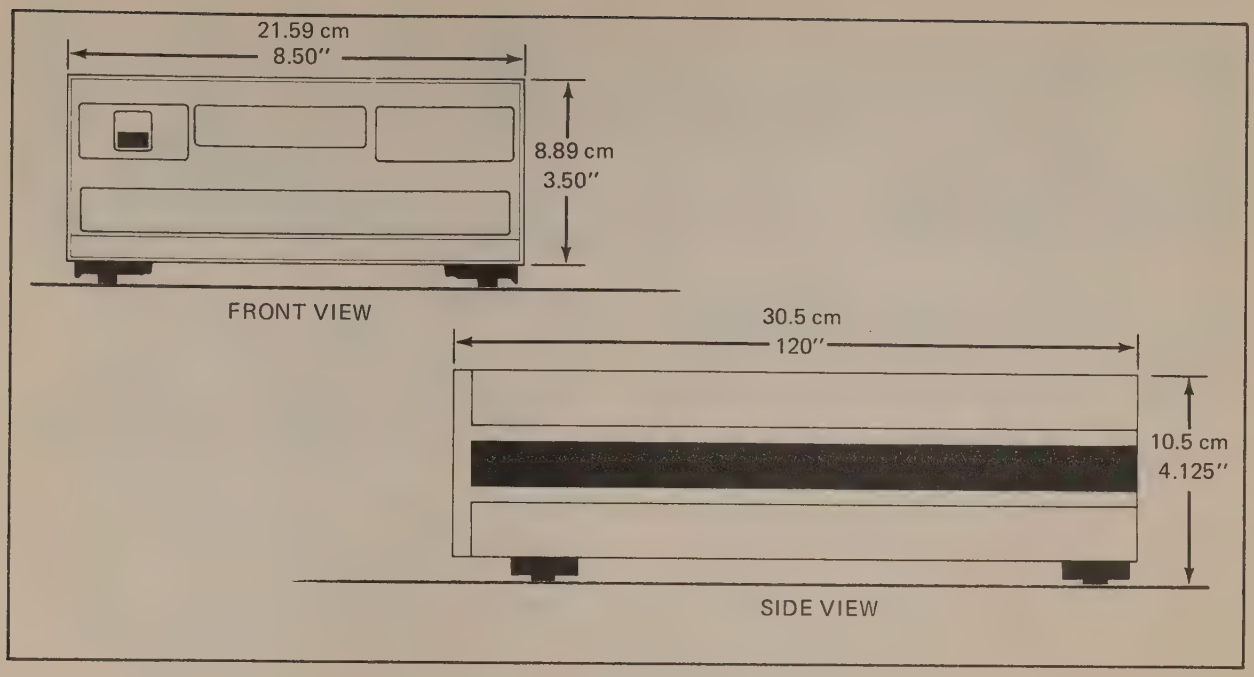


Figure 1-1. OVERALL DIMENSIONS

2100-04 - Analog Output Unit

Output: Linearized, isolated analog output.

Output Sensitivity: 1.0 mV/°F or °C, Thermocouple, Type J, K, E, T.
0.5 mV/°F, Thermocouple Type R and S,
1.0 mV/° C, Thermocou?le type R and S.

Output Current Drive: Up to 10 mA

Output Noise: 500 uV p-p worst case

Output Resolution: 0.4°F or °C

Accuracy: 0.5% of reading ±2 mV
90 days' 20 to 30°C

Variable Offset: 4 ranges, switch selectable

1° to 1000
1000 to 2000
2000 to 3000
3000 to 4000

Adjustable to any value within a selected range

Offset Temperature Coefficient: 200 uV/°C

Isolation: Fully isolated to 250V dc or rms ac.

2100A—06 - Digital Thermometer for six types of thermocouples

This is the same basic unit as the 2100A—03 but with the addition of 8 select switches on front panel. Instrument configuration for any one of the six available thermocouple types can be selected by means of the switches, but only one type of thermocouple can be connected at one time. Two additional switches for dc voltages of 40 mV and 400 mV are provided.

Accuracy Of Millivolt Ranges:

24 hrs, 23°C to 27°C	40mV - ±(0.01% of rdg + 2 digits)
or 72°F to 80°F	400mV - ±(0.01% of rdg + 1 digit)
90 days, 20°C to 30°C	40mV - ±(0.015% of rdg + 3 digits)
or 68°F to 86°F	400mV - ±(0.015% of rdg + 1 digit)
1 year, 15°C to 30°C	40mV - ±(0.03% of rdg + 4 digits)
or 59°F to 95°F	400mV - ±(0.03% of rdg + 2 digits)

2100A—10 - Digital Thermometer for ten thermocouples of the same type

This is the same basic unit as the 2100A—03 but with the addition of 11 manual switches on front panel. This allows up to 10 thermocouples (all of the same type) to be connected to the rear of the instrument and then switched, one at a time, into the measuring instrument. An error of 0.1°F or 0.1°C is added to the existing errors in the 2100A—03 specifications. A separate switch on the front panel isolates this bank of ten switches from external inputs when the 2150A is used. Channel identity of the selected thermocouple is available when the DOU is fitted.

2150A—10 - Ten point selector switch unit

This is a separate unit containing 10 manual selector switches on the front panel and a separate switch for isolating the switches. When used with any of the above instruments, the specification will be the same as the 2100A—10. When used with the 2100A—06, any combination of thermocouples can be connected to the unit. Channel identity can be recorded as in the 2100A—10.

2150A—20 - Twenty point selector switch unit

Same as 2150A—10, but with two rows of 10 selector switches.

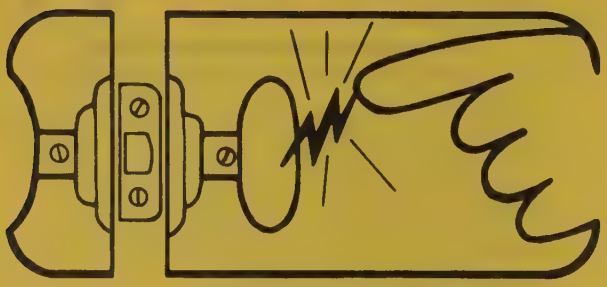
2150A—30 - Thirty point selector switch unit

Same as 2150A—10, but with three rows of 10 selector switches.

static awareness

A Message From

John Fluke Mfg. Co., Inc.



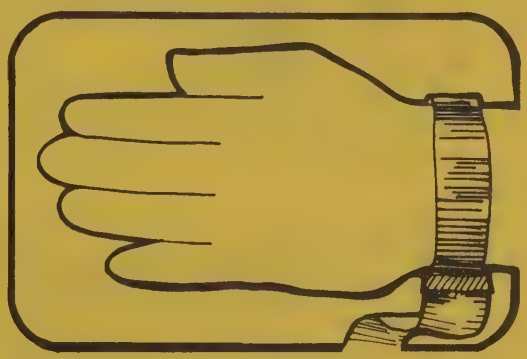
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

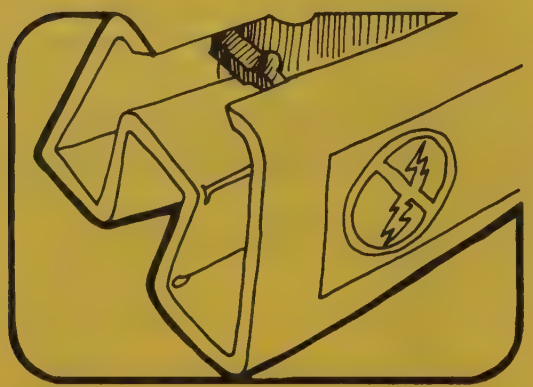
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

The following practices should be followed to minimize damage to S.S. devices.

1. MINIMIZE HANDLING

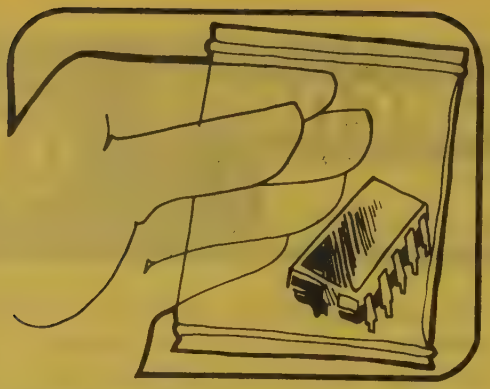


3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES

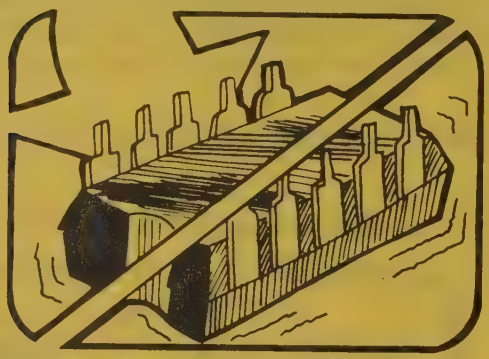


2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.

4. HANDLE S.S. DEVICES BY THE BODY

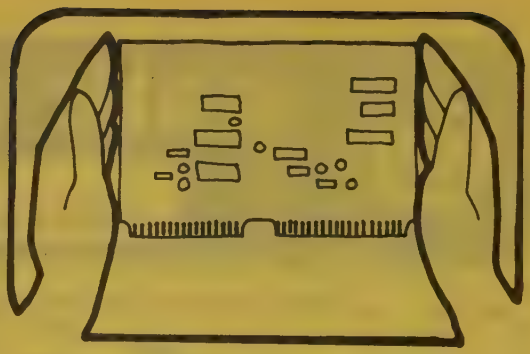


5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT

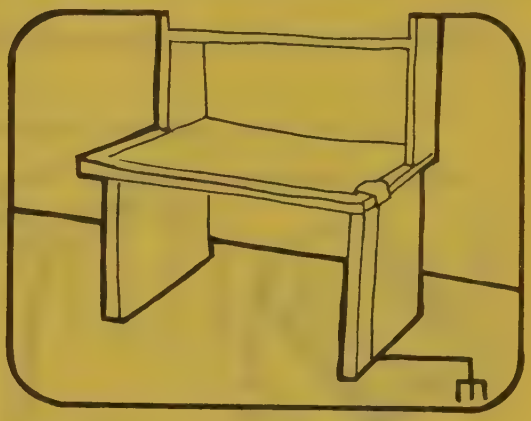


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet 30"x60"x60 Mil P/N RC-AS-1200 $20.00	Wrist Strap P/N TL6-60 $7.00

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AND GENERAL DYNAMICS, POMONA DIV.

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Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information regarding installation and operation of the Model 2100A Digital Thermometer. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation please contact your nearest Fluke Sales Representative, or contact the John Fluke Mfg. Co., P.O. Box 43210, Mountlake Terrace, WA, 98043; telephone (206) 774-2211. A list of Sales Representatives and their addresses is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The 2100A is packaged and shipped in a foam-packed container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please specify the equipment model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The 2100A can be operated from either an ac or dc power source. Ac power may be either 100, 115 or 230 volts, ±10%, at 50 to 440 Hz; however, each individual 2100A is configured for only one of these three ac voltages. The required ac line voltage is determined by means of the power transformer.

NOTE

The required ac line voltage for each 2100A is stamped on a decal located on the rear of the instrument.

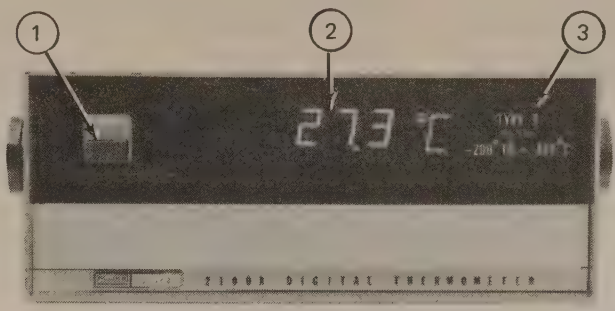
2-8. The 2100A may be connected to an 11.5 to 17.5 volt dc supply by means of a pair of rear panel terminals. The unit is protected from accidental polarity at the dc inputs, and may be connected concurrently to ac power. Refer to Figure 2-2 for the location of the ac and dc power inputs.

2-9. RACK/PANEL INSTALLATION

2-10. The 2100A can be installed in a standard, 19-inch equipment rack by means of the Offset Rack Mount Kit. A 2100A and a 2150A can be mounted together by means of Side-by-Side Rack Mount Kit. In addition, either of the two instruments can be panel mounted by means of the Panel Mounting Frame. Installation instructions for these accessories are included in Section 6.

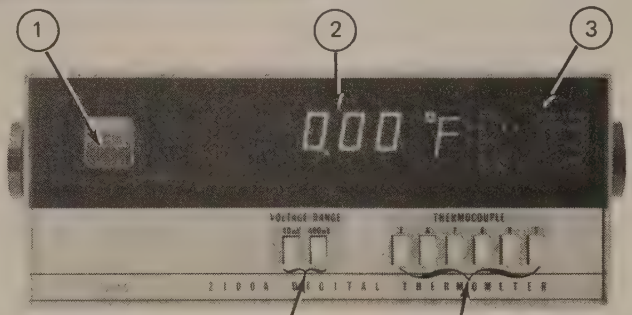
2-11. OPERATING FEATURES

2-12. The location of all front panel controls and indicators is shown in Figure 2-1; a description of each item shown is given in Table 2-1. Rear panel connectors are shown and described in Figure 2-2 and Table 2-2, respectively.



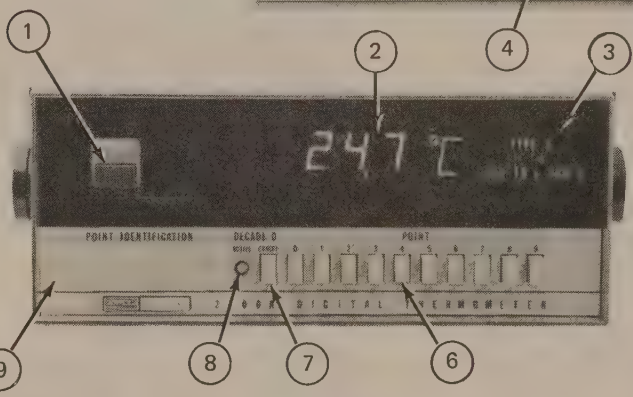
-03

(SEE DETAIL A)



-06

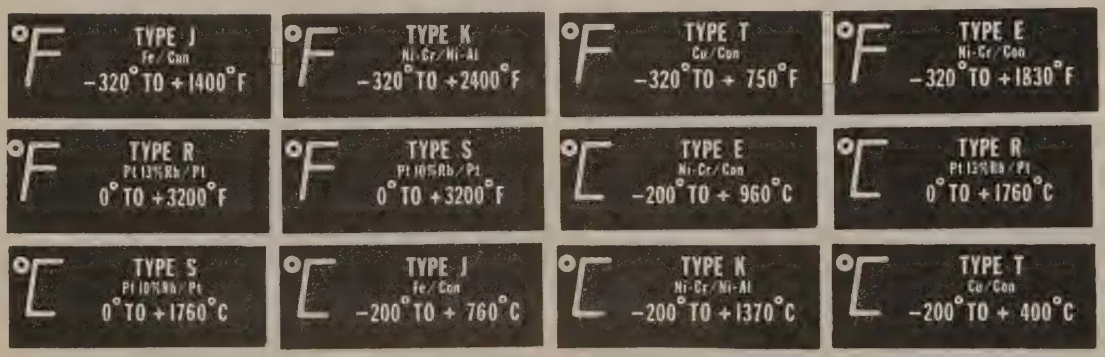
(SEE DETAIL A)



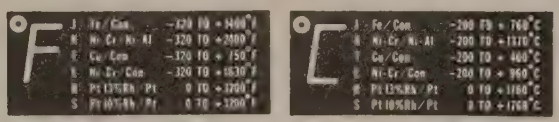
-10

(SEE DETAIL A)

DETAIL A


°F TYPE J Fe/Con −320° TO +1400° F
°F TYPE K Ni-Cr/Ni-Al −320° TO +2400° F
°F TYPE T Cu/Con −320° TO + 750° F
°F TYPE E Ni-Cr/Con −320° TO +1830° F
°F TYPE R Pt 13%Rh/Pt 0° TO +3200° F
°F TYPE S Pt 10%Rh/Pt 0° TO +3200° F
°C TYPE E Ni-Cr/Con −200° TO + 960° C
°C TYPE R Pt 13%Rh/Pt 0° TO +1760° C
°C TYPE S Pt 10%Rh/Pt 0° TO +1760° C
°C TYPE J Fe/Con −200° TO + 760° C
°C TYPE K Ni-Cr/Ni-Al −200° TO +1370° C
°C TYPE T Cu/Con −200° TO + 400° C

IDENTIFICATION DECALS FOR 2100A–03, –10



IDENTIFICATION DECALS FOR 2100A–06

Figure 2-1. FRONT PANEL CONTROLS AND INDICATORS

Table 2-1. FRONT PANEL CONTROLS AND INDICATORS

FIG. 2-1 INDEX NO.	NAME	DESCRIPTION
1	POWER Switch	Alternate-action pushbutton switch that switches power on and off. (When in off position, optional batteries are not charged.)
2	Measurement Results Readout	Five-digit Beckman (Planar gas discharge) readout that displays temperature, in degrees of scale noted on identification Decal (index No. 3). Maximum capacity of readout: ±39999.
3	Identification Decal	Identifies temperature scale and thermocouple type for which instrument has been programmed and calibrated.
4	Thermocouple Switches (J,K,T,E,R,S)	Mutually cancelling pushbutton switches that program the 2100A–06 for particular type of thermocouple being used. (Permits rapid change from one type to another.)
5	VOLTAGE RANGE Switches (40 mV, 400 mV)	Mutually cancelling pushbutton switches that select desired input voltage range when 2100A–06 is used with devices other than thermocouples (such as strain gauges). *NOTE* *All eight pushbutton switches form a single group insofar as mutual cancellation is concerned; only one of the eight can be active at a given time.*
6	POINT Switches (0 thru 9)	Mutually cancelling pushbutton switches that select desired thermocouple for input to 2100A–10.
7	DECADE 0 CANCEL Switch	Pushbutton switch that mechanically releases selected POINT switch on 2100A–10 when 2150A is used to expand number of inputs.
8	DECADE 0 ACTIVE Indicator	LED that lights red to indicate DECADE 0 is active (a POINT button has been pressed). LED goes out if CANCEL button is pressed. Used on 2100A–10.
9	POINT IDENTIFICATION Log	Writing surface on 2100A–10 provided to log locations of thermocouples used.

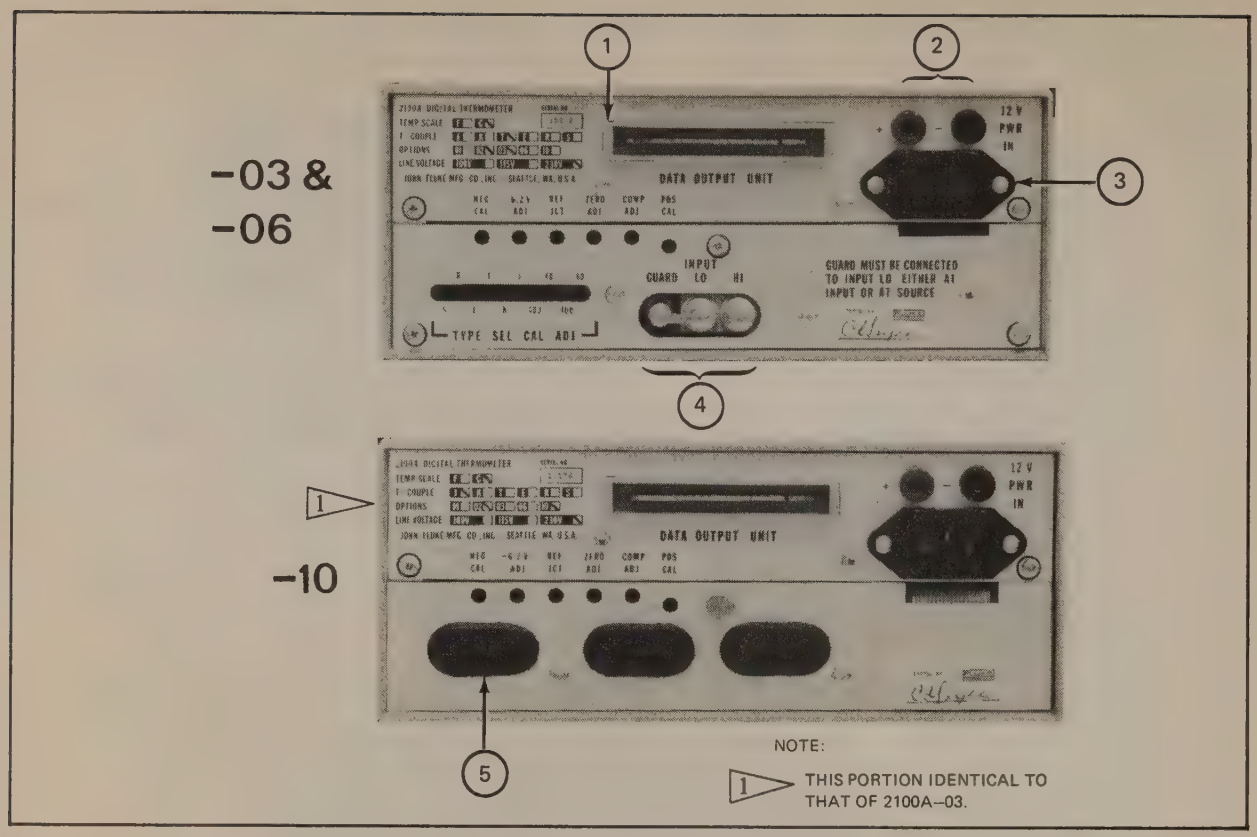


Figure 2-2. REAR PANEL CONNECTORS

Table 2-2. REAR PANEL CONNECTORS.

FIG. 2-1 INDEX NO.	NAME	DESCRIPTION
1	DATA OUTPUT UNIT Connector	Card-edge connector that permits connection to external digital equipment. (Part of –02 option.)
2	12V PWR IN jacks (+, –)	Two connectors that provide means of attaching an external dc power source.
3	AC Pówer Input Connector	Polarized, three-prong connector that provides means of connecting ac power source.
4	INPUT Terminals – GD, LO, HI (2100A–03 and 2100A–06 only)	Three screw-and-lug terminals that provide means of connecting thermocouple with or without guard. The 2100A–06 will also accept voltage inputs from other types of transducers, such as strain guage configurations, etc.
5	Input Terminals (2100A–10)	Same type terminals as item 4, but arranged in 10 front-to-back rows of 3 terminals each (GD, LO, HI, back-to-front). Terminals provide means of connecting up to 10 thermocouples, with or without guard.

2-13. OPERATING NOTES

2-14. The following paragraphs describe various conditions that should be considered before operating the 2100A.

2-15. AC Line Connection

2-16. The input power cord mates with a three-prong, polarized connector. This permits connection to any of the power line voltages described in paragraph 2-6. Ensure that the offset pin is connected to a high-quality earth ground.

2-17. Fuse Replacement

2-18. A ¼A fuse is located in a snap-in fuseholder near the power transformer as shown in Figure 2-3. Should the fuse need replacing, remove the 2100A from the case to gain access to the fuse by removing the four retaining screws on the rear panel and sliding the instrument backwards. Replace the fuse with a ¼A Slo-Blo, Fluke part number 166306.

2-19. Open Inputs

2-20. Open inputs (thermocouple either burned open or not connected), when applied to the 2100A, will cause the readout to go blank. In addition, the readout on the 2100A-10 and 2100A/2150 set will go blank if the CANCEL button corresponding to the lighted ACTIVE indicator is pressed. If all available ACTIVE indicators are out, the blank display is not indicative of an open input. If, however, any ACTIVE indicator is lit, then a blank display indicates that the input selected in tht active decade is open.

2-21. OPERATION

2-22. Models 2100A–03 and 2100A–10

2-23. Operate the 2100A–03 and 2100A–10 as follows:

a. Connect thermocouple leads to the input terminals on the rear panel (2100A–03) or to one of the ten sets of terminals located inside the lower half of the rear panel (2100–10). The thermocouple must be of the type indicated on the decal in the upper right corner of the front panel.

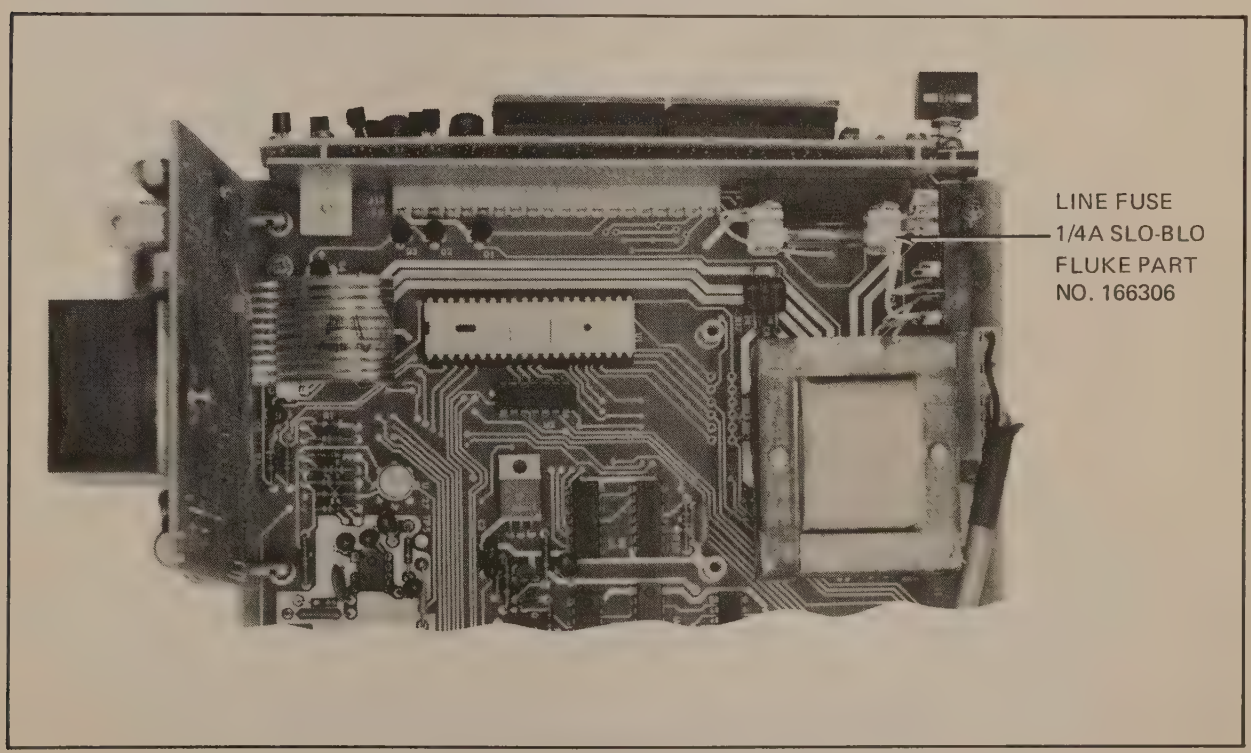


Figure 2-3. LINE FUSE LOCATION

NOTE!

The first metal of the thermocouple, as indicated on the front panel decal, connects to the HI terminal; the second metal connects to the LO terminal. If the thermocouple is guarded, connect the shield to the GD (guard) terminal and the sensor end of the shield to ground; if not, connect the GD and LO terminals together.

NOTE!

On the 2100A–10 only, unscrew the knurled captive screw (center of the rear panel) and pull the lower half of the instrument out of the case to expose the input terminal block. Be sure to route the thermocouple leads through the grommeted holes in the rear panel.

b. Connect the 2100A to the proper power source. (Refer to paragragh 2-6).

c. Press the POWER pushbutton. For the 2100–03, verify that the readout lights.

NOTE

Steps a, b, and c are all that are required for 2100A-03 operation. For 2100A-10, proceed with steps d, e, and f.

d. Press the POINT selector corresponding to the location (0 through 9) to which the thermocouple is attached; verify that the readout and ACTIVE indicator lights.

e. To select a new thermocouple, press the desired POINT selector (no need to press CANCEL button first).

f. To open all inputs, press the CANCEL button and verify that the ACTIVE indicator and readout both go out.

2-24. Model 2100A–06

2-25. Operate the 2100A–06 as follows:

a. Connect 2100A–06 to proper power source. (Refer to Paragraph 2-6.)

b. Connect leads of desired type of thermocouple to input terminals on rear panel. (Any one of the six available types may be used.)

c. Press THERMOCOUPLE selector pushbutton corresponding to type of thermocouple connected in step b, or press desired VOLTAGE RANGE pushbutton if using the 2100A–06 as a millivolt meter.

d. Press POWER pushbutton; verify that readout lights.

NOTE

The 2100A–06 may only have one set of input leads connected at any time.

2-26. Model 2100A/Model 2150A Set

2-27. When a 2150A is used in conjunction with a 2100A, each decade of the 2150A is operated in the same manner as DECADE 0 of the 2100A–10. That is, to select a new point in the active decade, merely press the POINT pushbutton for the new point. (The active decade is indicated by a lighted ACTIVE indicator.) However, to select a new point in a different decade, the active one must first be deactivated. This is accomplished by pressing the CANCEL pushbutton in the active decade (ACTIVE indicator will go out). When all ACTIVE indicators are unlit, any of the total points available (up to 30 for the –03 and –06; up to 40 for the –10) may be selected.

2-27. In the case of the 2100A–06/2150 set, thermocouples of any of the six types may be connected to the input connectors on the 2150A in any order (mix as desired). However, after a given point has been selected, the THERMOCOUPLE pushbutton on the 2100A–06 corresponding to the type of thermocouple connected to the selected point, must be pressed.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 2100A Digital Thermometer. The theory is presented at a functional block level followed by a more detailed description. The section titled OVER-ALL FUNCTIONAL DESCRIPTION discusses the overall operation of the instrument in terms of the functional relationships of the major circuit areas. Block diagrams and simplified circuit diagrams are used as aids to understanding the instrument theory. The section titled CIRCUIT ANALYSIS provides more detailed information about the circuit operation within each functional block.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. The 2100A processes the thermal emf output of a thermocouple in such a manner as to produce an accurate digital representation of the temperature causing the thermocouple output. Figure 3-1 illustrates, in block diagram form, the steps that the thermocouple output goes through as it is processed for display. The basic purpose for each functional block will be discussed in the following paragraphs.

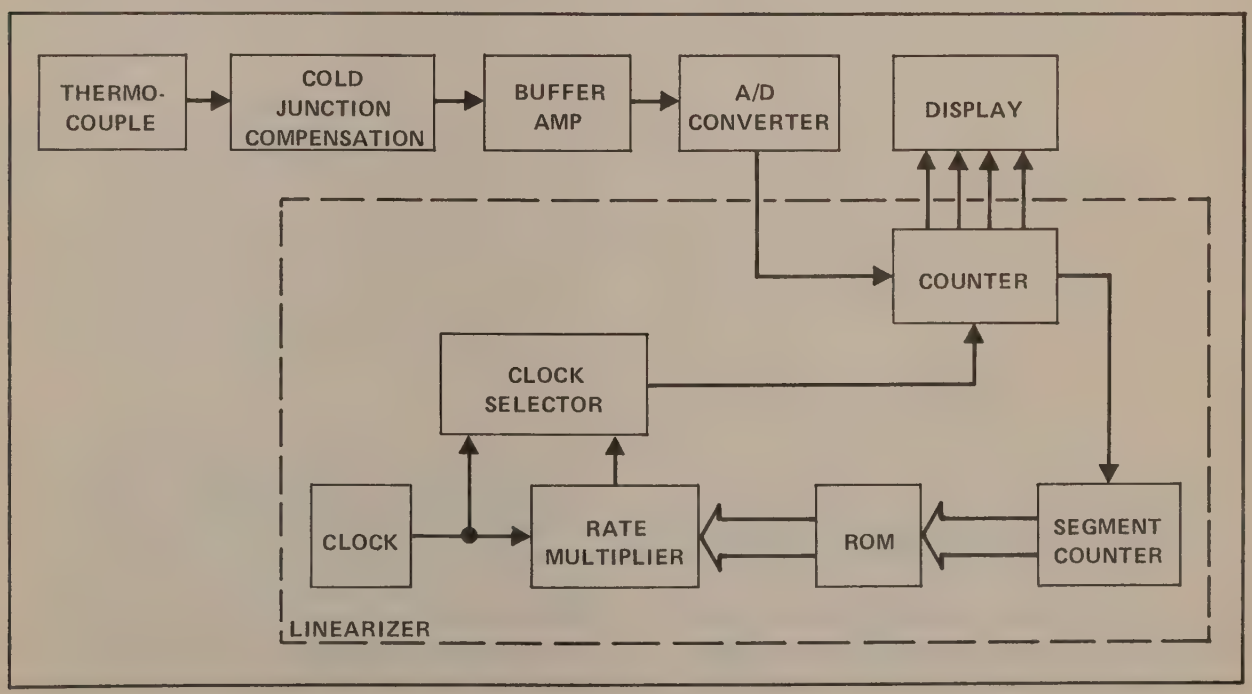


Figure 3-1. 2100A BLOCK DIAGRAM

3-5. Thermocouple

3-6. Three types of thermocouples (J type, K type, and T type) are available as accessories to the 2100A. The E, R, and S type thermocouples are also compatible with the 2100A. These thermocouples consist of two dissimilar metals (wires) connected together at the probe end and attached to the cold junciton on the 2100A. Figure 3-2 is a basic representation of the thermocouple; illustrating how it is attached to the instrument.

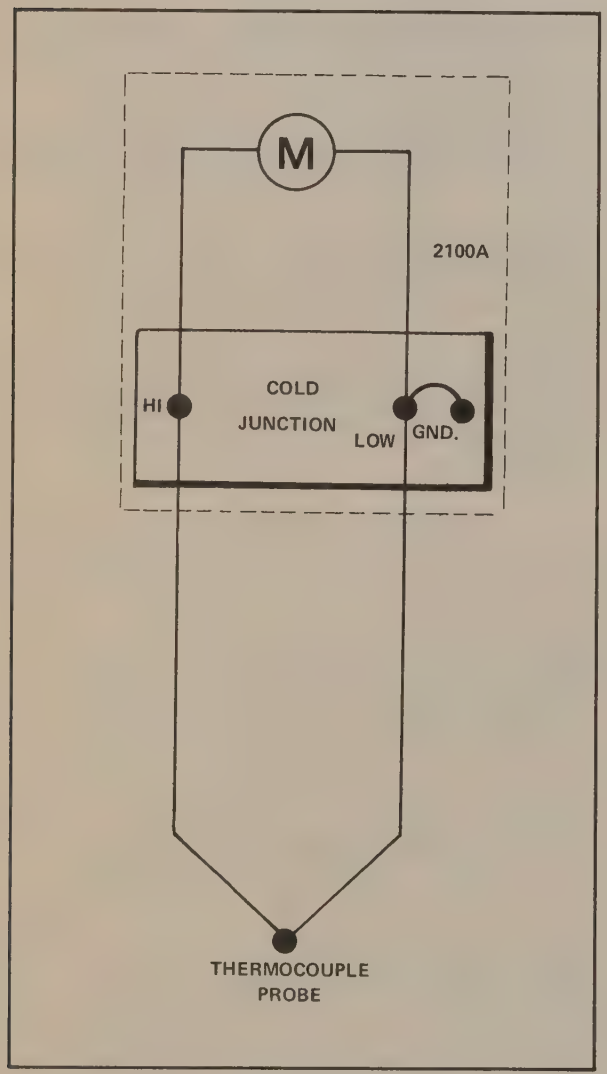


Figure 3-2. THERMOCOUPLE CONNECTION

3-7. The thermal emf generated by the thermocouple changes as the temperature varies. These changes in emf are processed by the 2100A and displayed as a digital representation of the temperature.

3-8. Cold Junction Compensation

3-9. The conversion from thermocouple materials to copper, for connection to the measuring device, must be done with both thermocouple to copper junctions at the same temperature. Temperature gradients or variations at these connections will introduce errors. The 2100A uses an isothermal block containing the terminals for connecting thermocouples to the instrument. The heat conductivity of the isothermal block holds the two thermocouple connection terminals very close to the same temperature. The temperature of the block is monitored by a transistor; the emitter-base junction characteristic of which has been calibrated against changes in temperature. The cold junction is electrically compensated for changes in temperature that would otherwise create an error in the detected temperature at the thermocouple probe.

3-10. Buffer Amplifier

3-11. The buffer amplifier is used to maintain the amplitude of the signal applied to the integrator at approximately the same level for any of six 2100A compatible thermocouples. The amount of buffer amplifier gain applied to each thermocouple output is controlled by changing the amplifier feedback loop resistor. Each thermocouple has its own thermal emf output versus temperature curve as shown in Figure 3-3. The variation in thermal emf output from one thermocouple to another is compensated for by changing the amplifier gain to match each type thermocouple.

3-12. A/D Converter

3-13. The analog to digital (A/D) converter receives a dc voltage output from the buffer amplifier, representative of the thermal emf of a thermocouple, and integrates it for 100ms. The voltage level stored in the integrator capacitor at the end of 100ms is directly proportional to the thermal emf output of the thermocouple, and therefore representative of the temperature. Figure 3-4 illustrates how the integrator output would appear for various percentages of full scale inputs.

3-14. The integrator charges a capacitor during the integrate period (100ms) such that the amount of charge at the end of the period is a direct result of the level of thermal emf applied to the instrument. At the end of the integrate period the input from the thermocouple is electrically disconnected from the buffer amplifier input and replaced by a reference voltage. The reference is a fixed voltage level opposite in polarity to the input applied during the integrate period.

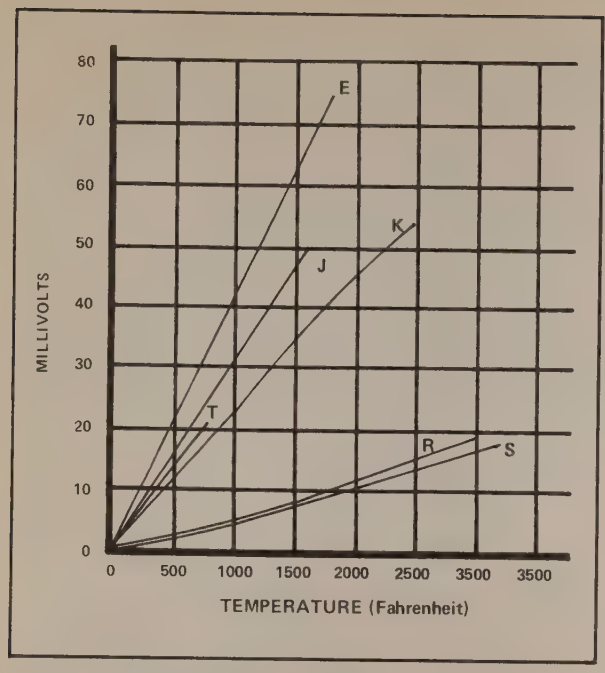


Figure 3-3. TEMPERATURE/MILLIVOLT FOR THERMOCOUPLES

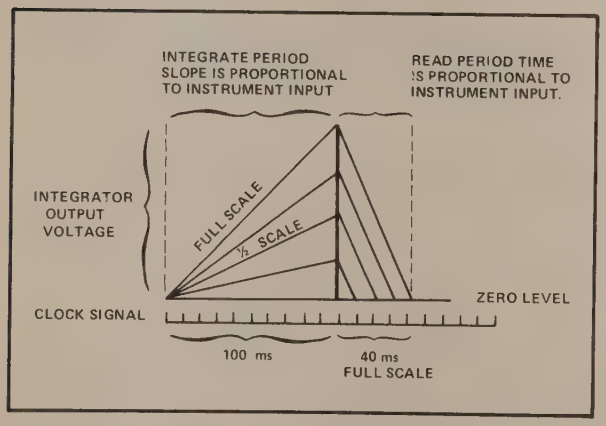


Figure 3-4. DUAL-SLOPE A/D CONVERSION

3-15. During the read period the reference voltage is integrated causing the charge on the integrator capacitor to discharge at a predetermined rate. The time required to discharge the capacitor to the zero level during the he read period depends upon the level the capacitor was charged to during the integrate period. A digital representation of the input (thermal emf) is obtained by counting the number of cycles of a clock signal that occur from the start of the read period until the integrator capacitor has been discharged to the zero level. A comparator attached to the integrator output detects the point when the integrator capacitor reaches the zero level and issues a compare signal to stop counting the cycles of the clock signal.

3-16. Linearizer

3-17. The linearizer comprises a counter, segment counter, read only memory (ROM), rate multiplier, clock selector and clock. The purpose of the linearizer is to adjust the digital count as compensation for the nonlinear thermal-emf-versus-temperature curves of each type thermocouple. A close look at Figure 3-3 will reveal that thermocouples not only have different thermal-versus-temperature curves but each curve in itself is not linear.

3-18. At the start of the read period the clock, via the rate multiplier (multiplies by fractions), supplies the counter with a clock signal at a particular frequency. As the counter accumulates the cycles of the clock signal it will output one pulse to the segment counter for every 100 cycles of input to the counter. The segment counter, being tailored to each type of thermocouple, provides an address change command to the ROM after a predetermined number of input pulses from the counter. The address change in the ROM inturn changes the fractional multiplier used in the rate multiplier to control the frequency of the clock signal applied to the counter. The change in clock signal frequency compensates for the non linear thermal emf versus temperature characteristic of the thermocouple.

3-19. Display

3-20. The total number of cycles of the clock signal accumulated by the counter are a digital representation of the temperature at the thermocouple probe. The display processes the accumulated count to provide the proper numeric display on the gas discharge front panel readout.

3-21. CIRCUIT ANALYSIS

3-22. Reference Junction Compensation

3-23. Compensation for thermal emfs generated by the thermocouple connection terminals is provided by Q1, U32, and associated components. The difference in emf per degree change of temperature, caused by each type thermocouple, is corrected by selected values of R_c and R_d. Figure 3-5 is the reference junction compensation portion of the schematic.

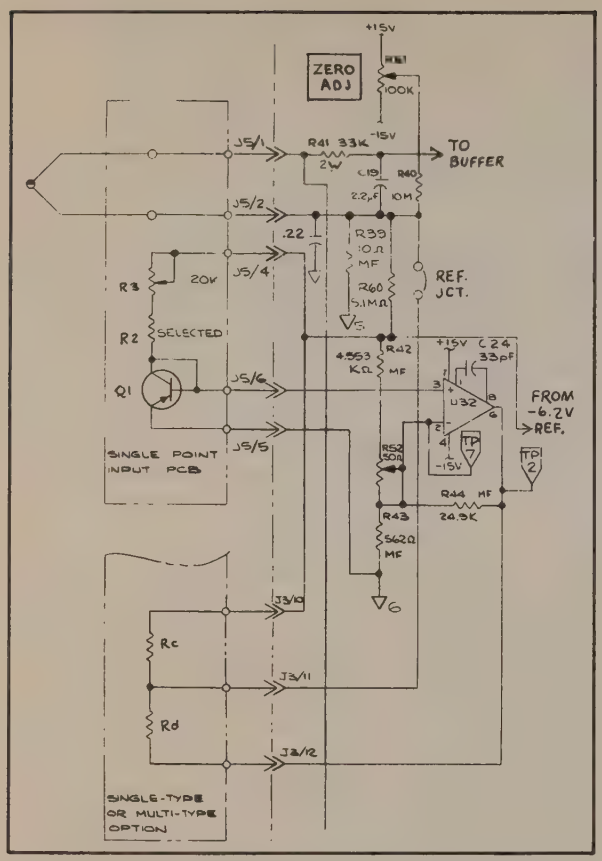


Figure 3-5. REFERENCE JUNCTION COMPENSATION CIRCUIT

3-24. Operational amplifier U32 is biased, to conduct at a stable rate, by the –6.2 reference voltage. The amplifier's output is connected through resistor R_d and the REF JCT jumper to the junction of R39, R40, and R60. The current through R39 develops a small voltage which, during calibration, is offset by the ZERO ADJ. control. When the temperature of the isothermal block (the connection point for the thermocouple) changes, Q1 causes the voltage applied to the positive input to U32 to change. The change in the input voltage is amplified by U32 about 50 times. As the output of U32 changes the voltage developed across R39 also changes, compensating for the change in the connection terminals thermal emf output.

3-25. Buffer Amplifier

3-26. The Buffer Amplifier and its input control circuit is presented in Figure 3-6. The buffer is comprised of Q13, U30, CL1, and associated circuitry. The input control circuit is divided into two basic functions; connecting the thermal emf of the thermocouple to the buffer during the integrate period, then the reference voltage during the read period. The control signals for each function come from the LSI chip U1 (not shown).

3-27. The thermal emf output of the thermocouple is applied to the buffer, via Q16, for the duration of the 100 ms $\overline{\text{INT}}$ command (integrate period). The buffer output is ap-

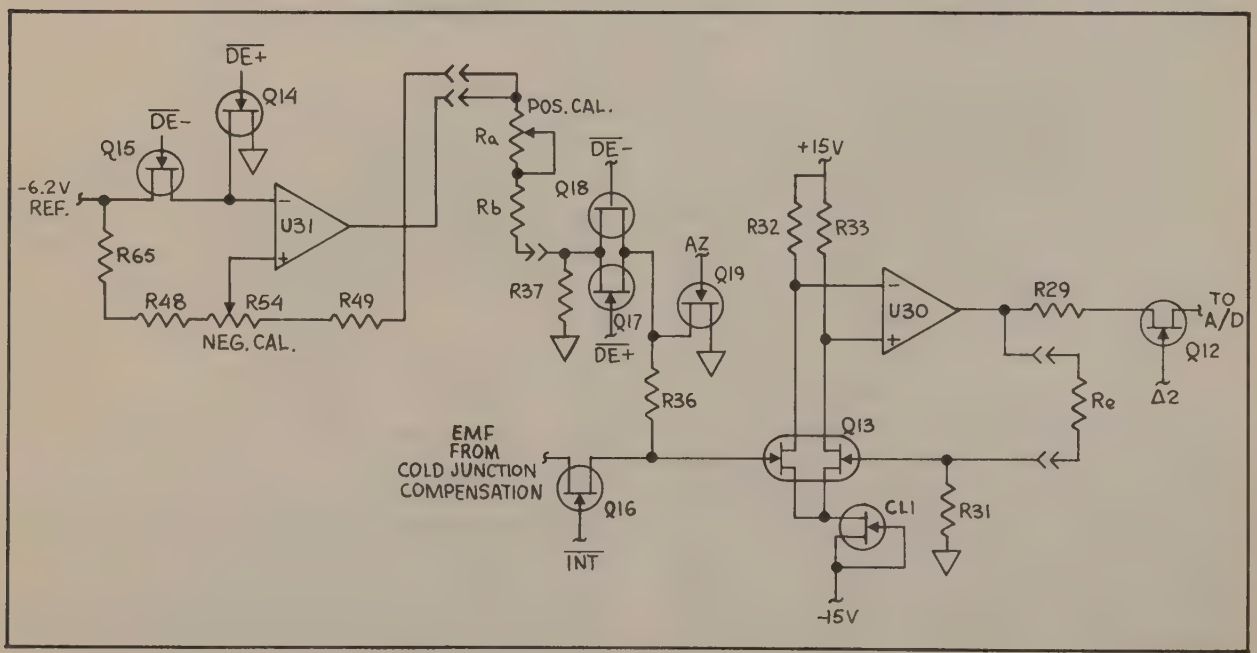


Figure 3-6. BUFFER AMPLIFIER CIRCUIT

plied to the A/D, via R29 and Q12, for 100 ms. At the end of the 100 ms $\overline{INT}$ command, a 1 ms Δ 2 command isolates the buffer from the A/D by opening Q12. This allows the input to the buffer to be switched from the thermal emf input to a reference supply input without affecting the A/D. The polarity of the reference voltage to be applied to the buffer is selected by the $\overline{DE}$ – command (negative reference) or DE + command (positive reference). If the thermal emf input is positive then the $\overline{DE}$– command will cause Q15 to conduct applying the –6.2V REF to the non-inverting input of U31. The negative output voltage from U31 is connected via Q18, closed by the $\overline{DE}$ – command, to the buffer input at Q13. The level of the reference voltage applied to the A/D is selected for each type thermocouple used and for Celsius or Fahrenheit operation. The value of R_e in the buffer feedback circuit and the values of R_a and R_b in the reference supply circuit determine the level of the reference voltage output of U30.

3-28. At the end of the read period, the $\overline{DE}$ – command will go high causing Q15 and Q18 to stop conducting. The $\overline{AZ}$ command then causes Q19 to conduct. The input of the buffer is connected to ground through Q19 to insure that any residual voltage that may be present is eliminated. This insures that no offset will be added to the thermal emf or reference voltage applied to the buffer during the next reading.

3-29. A/D Converter

3-30. A simplified schematic representation of the A/D Converter is provided in Figure 3-7. The circuit consists of an integrator (U29) which charges C12 during the integrate period then discharges it at a controlled rate during the read period, and a comparator (U28) that senses the polarity of the thermal emf input and provides a compare signal to U1 to indicate when C12 is discharged.

3-31. During the 100 ms $\overline{INT}$ command (integrate period) the input to the A/D is a voltage that directly represents the thermal emf output of the thermocouple. This voltage causes U29 to charge C12. The buffer output is applied, through R29, to the inverting input of U29, therefore a positive input will cause C12 to charge to a negative value. The negative charge of C12 is applied to the inverting input of U28. The negative input causes the output of U28 to immediately go to +5 volts and remain at that level until the input returns to zero.

3-32. At the end of the 100 ms integrate period, the input to U29, from the buffer Amplifier, is changed to a reference voltage. Because the reference voltage is opposite in polarity, U29 starts to discharge C12. The rate at which C12 discharges is directly related to the value of the reference voltage. The greater the charge in C12 at the end of the integrate period, the longer it will take to discharge. When the charge on C12 reaches zero, the output of U28 (cm) immediately returns to zero volts. This transition signals the end of the read period and is used in U1 to terminate the digital count.

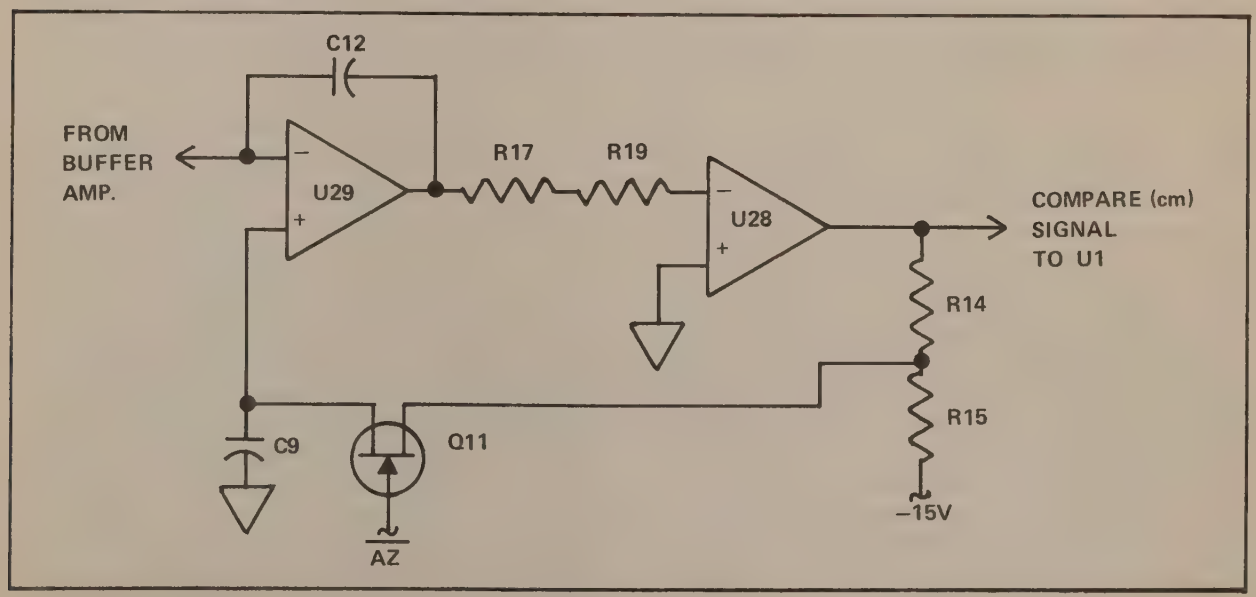


Figure 3-7. A/D CONVERTER CIRCUIT DIAGRAM

3-33. Linearizer

3-34. The following discussion of the operation of the Linearizer refers to sheet 4 of 5 of the Basic Instrument schematic in Section 8. Refer to that schematic when reading the following description of the theory of operation of the Linearizer.

3-35. CLOCK

3-36. The Clock basically consists of crystal Y1 and two CMOS inverters of U25. The 1 MHz output of the Clock is applied to the Clock Selector and to the Rate Multiplier.

3-37. CLOCK SELECTOR

3-38. The Clock Selector has two inputs, one from the clock and one from the Rate Multiplier. The 1 MHz clock signal is selected for output to the Counter (U1) during the integrate and auto zero periods, when the 40 mV or 400 mV range is selected, or when the linearizer jumper is removed. The input from the Rate Multiplier is applied to the counter only during the read period when measuring temperature. The frequency of the rate multiplied clock signal depends upon the type thermocouple used and at which point in the thermocouples' temperature range the input temperature is.

3-39. SEGMENT COUNTER

3-40. The Segment Counter contains two functionally separate sections, one being a segment length counter and the other a segment address counter. These two sections control signals to the ROM tailored to the particular type of thermocouple being used.

3-41. The segment length counter receives an input signal from the counter U1 pin 35 (TA ÷ 100) equal to one positive true pulse for each 100 clock signal input pulses at U1 pin 6. The TA ÷ 100 signal is applied to U19-1. The outputs of U19 at pins 15, 14, 13, and 11 are applied to a series of AND gates (U13, U14, and U18) which are programmed, by the single-type pcb or the type select switch on the multi-type pcb, to provide one output pulse at U9-6 for each 2, 3, 4, or 5 TA ÷ 100 input pulses. This defines a segment length to be equal to 20, 30, 40, or 50 degrees of the thermocouples temperature range. The individualized segment lengths compensate for the differences in temperature range of each type thermocouple. The output of the segment length counter from U5-6 is applied to the segment address counter.

3-42. The purpose of the segment address counter is to program a new output from the ROM for each new segment. The output of the segment length counter is applied to U20 pin 14 and U15 pins 9 and 12. The output of U20 at pins 12, 9, 8, and 11 is a binary equivalent of the total of the input pulses at U20-14. When the total reaches 15, all the inputs to U23 will be high causing the output to go low. The low output is inverted by U6-13 and applied to pins 8 and 11 of U15. The sixteenth pulse from the segment length counter will clock U15-9 causing a high output to pass through OR gate U24-1 to the ROM. The Thirty-third input pulse will clock U15-12 causing a high output to pass through U24-4 to the ROM.

3-43. The DE+ signal from U1 pin 38 will be low when the input to the 2100A is negative. This signal is attached to U9 pins 9 and 13 to cause the Segment Address Counter to start at the count of 48 when the temperature at the thermocouple falls below 0°C or F. The addresses in the ROM from 48 through 63 are reserved for segments of the thermal emf response curves (J, K, T, and E types) corresponding to temperatures below 0°C or F. Addresses from 0 to 47 are used for positive temperatures. All 64 segments are used for positive temperatures for the R and J thermocouples.

3-44. ROM

3-45. The Read Only Memory (ROM) contains preprogrammed eight-bit binary numbers which are used by the Rate Multiplier to alter the clock signal frequency. Three program address lines, U22 pins 14, 15, and 16, determine which series of numbers the inputs from the Segment Address Counter will select from. At each address in a particular series, an eight–bit number is stored that is representative of the slope of that segment of the thermocouple emf versus temperature curve. The outputs of the ROM are applied to the Rate Multiplier.

3-46. RATE MULTIPLIER

3-47. The Rate Multiplier includes a six-bit counter multiplier U21, NAND gates U11 and U12, and dual flip-flop U10. The 1 MHz signal from the clock is applied to U21 pin 9 and, via inverter U16-8, to the clock inputs of U10-9 and U10-12. Six of the eight bits of the number input from the ROM are applied to the six bit counter multiplier U21. The two most significant bits of the data word are applied to U12 pin 1 and U11, pin 3. The eight bit number is selected to produce a fractional multiplier between 0/256 and 255/256. When the 1 MHz clock signal is multiplied by the fraction, the resulting clock signal is applied to U17, pin 9. When the DE signal from U1-37 goes low (read period), the rate multiplied clock signal will be applied to the input to the Counter U1-6. At the end of each segment, the Segment Address Counter advances the ROM, to the next address location and provides a new eight bit data word to the Rate Multiplier.

Segment Address Counter advances the ROM, to the next address location and provides a new eight bit data word to the Rate Multiplier.

3-48. Summary of Linearizer Operation

3-49. The following summary of the operation of the Linearizer uses the timing diagram in Figure 3-8 to illustrate the closed loop interaction of the subsections of the Linearizer. The diagram represents the first five segments of a hypothetical thermal emf versus temperature curve. In actuality the change in frequency at U1-6, from one segment to the next, would not be as great as that shown in the timing example.

3-50. For this example, the segment length counter is assumed to be programmed to provide a two-to-one division ratio; i.e., each segment represents 20 degrees of temperature. The ROM is programmed for a rate multiplier of 192 over 256 (eight bit number, B7 thru B0, is 1100000) resulting in a clock input to the Counter (U1-6) of 750 kHz during segment number 0.

3-51. At the start of the read period, the Clock Selector will apply the 750 kHz clock frequency (U21-6) to the Counter. On the one-hundredth clock pulse, the output of the Counter (U1-35) produces one positive pulse. On the two-hundredth pulse, the output of the Counter produces the second positive pulse which causes the segment length counter to output one negative pulse (U5-6) to the segment address counter. This pulse causes the segment address counter, via U20–12, to advance the ROM address to access the next eight bit number (segment number 1). The eight bit data word stored in the ROM, for this example, is 10100000 (output lines B7 thru B0). This data word will cause the Rate Multiplier to change to 160 over 256 which causes the clock frequency to change to 625 kHz. The sequence of events is the same as it was for segment number 0 in that the Counter will output one pulse at one hundred counts, then a second pulse at two hundred counts which advances the segment address counter to segment number 2 (U20-12 low, U20-9 high). This results in a binary number 10000000 output from the ROM, a rate multiplier of 128 over 256 and a new clock frequency of 500 kHz.

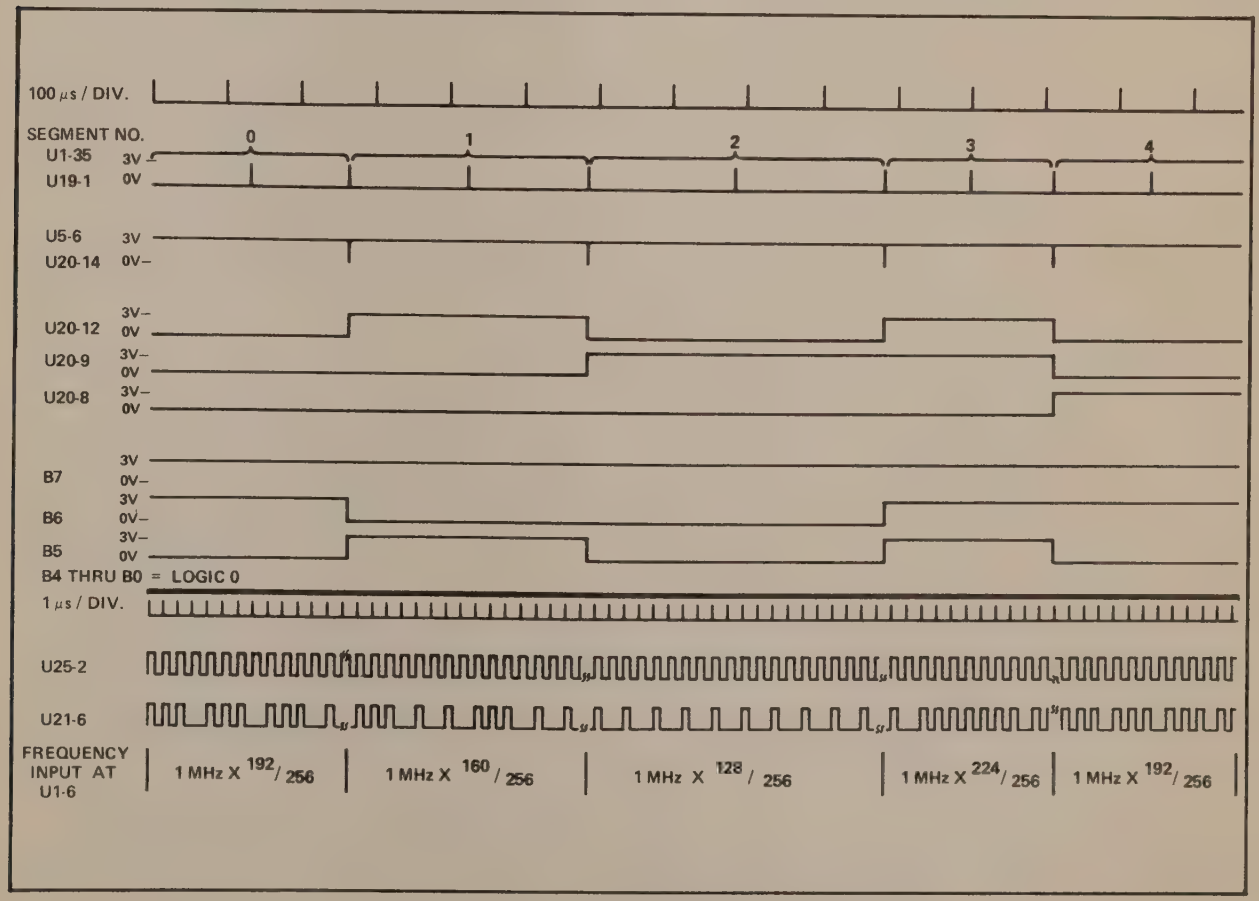


Figure 3-8. LINEARIZER TIMING EXAMPLE

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2100A Digital Thermometer. This includes service information, general maintenance, operational evaluation, calibration, and troubleshooting. The performance test is recommended as a preventative maintenance tool, and should be executed when it is necessary to verify proper instrument operation. A calibration interval of one year is recommended to insure that the 2100A is within the one-year specifications. Table 4-1 lists the recommended test equipment necessary to maintain the 2100A If the recommended equipment is not available, other equipment having equivalent specifications may be used.

4-3. The 2100A instrument is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is given on the back of the title page located in the front of this manual. For the WARRANTY to become effective, the validation card included with the instruction manual must be filled out and returned to the John Fluke Mfg. Co., Inc.

4-4. GENERAL MAINTENANCE

4-5. Access Information

4-6. Use the following procedure to gain access to the interior of the 2100A.

a. Remove the line power cord.

b. Remove the encircled screws from the right and left edges of the rear panel. (There are four screws, two each side, on the 2100A–03 and 2100A–06, and two screws, one each side, on the 2100A-10).

c. Slide the inner chassis out of the outer case by pulling the rear panel straight back.

NOTE

When placing the chassis back into the case, insure that the chassis edges are properly aligned with the guide rails in the outer case.

Table 4-1. RECOMMENDED TEST EQUIPMENT

EQUIPMENT NOMENCLATURE	SPECIFICATIONS	RECOMMENDED MODEL
DC Voltage Calibrator	Output Voltage: 10 Volts Voltage Accuracy: 0.002% + 10μV	Fluke Model 332B
Kelvin Varley Voltage Divider	Absolute Linearity: ±0.1 ppm Resolution: 0.1 ppm	Fluke Model 720A
Voltmeter	Accuracy: (0.005% of input +0.001% of range) Resolution: 0.001% of range	Fluke Model 8375A
Calibration Thermometer	Resolution: 0.02°C	Princo ASTM-56C
Flat Cable Connector	John Fluke P/N 376285	

4-7. Cleaning

4-8. Clean the 2100A periodically to remove dust, grease, and other contamination. Use the following procedure:

CAUTION!

Do not use aromatic hydrocarbons or chlorinated solvents to clean the 2100A. They will react with the plastic materials used in the instrument.

a. Clean the surface of the pcb using clean dry air at low pressure (≤ 40 psi). If grease is encountered, use a mild solution of detergent and water and a soft bristled brush to dislodge the contaminants.

b. Clean the outer surfaces of the instrument with a soft cloth dampened in a mild solution of detergent and water.

4-9. Fuse Replacement

4-10. The input power fuse F1 is located in the left front corner of the Basic PCB near the power transformer. If replacement is necessary, use a ¼ ampere slo-blo fuse.

4-11. Service Tools

4-12. No special tools are required to maintain or repair the 2100A.

4-13. OPERATIONAL EVALUATION

4-14. The operational evaluation of the 2100A is designed to check the instrument's ability to correctly process input voltages in the range generally produced by thermocouples. The test can be used as an acceptance check and/or a periodic maintenance check. If the 2100A fails this evaluation corrective action, either recalibration or repair, will be required. The test equipment required to perform this evaluation is listed in Table 4-1. Troubleshooting information is given later in this section of the manual.

4-15. Use the following procedure to evaluate the operation of the 2100A.

a. Connect the appropriate thermocouple to the 2100A–03 or –10 input terminals. (For the 2100A–06 use the J-type thermocouple.)

b. Connect the 2100A to the line power, turn it on and allow one-half hour warmup.

c. Insert the thermocouple and a mercury-in-glass calibration thermometer (PRINCO ASTM -56C) into a room temperature lag bath to a depth of four inches. Allow at least 10 minutes for temperature stabilization.

d. Read the temperature indicated on the calibration thermometer.

e. Check the 2100A display for a temperature indication within the specification limits as defined in Section 1 of this manual.

4-16. CALIBRATION

4-17. The 2100A should be calibrated at least once a year or whenever repairs have been made. (If accuracy requirements, more stringent than the one year specifications indicate, are required, then the calibration interval should be reduced.) The calibration procedure should be performed under environmental conditions providing temperatures of 20°C to 26°C and himidity less than 80%. Table 4-1 lists the required test equipment.

NOTE

The 2100A is calibrated using the International Practical Temperature Standard of 1968. Any thermocouple table predating this 1968 issue should not be used to calibrate the 2100A.

4-18. Power Supply Adjustments

4-19. Use the following procedure to correctly adjust the power supply output.

a. Connect the positive input lead of the voltmeter to the junction point of C12, CR10, and CR11 (on the Power Supply PCB) and the negative input lead to the logic common side of C12 (See Figure 4-1).

b. Adjust R4 for a voltmeter indication of 5.2V , ±0.02V.

c. Check the voltage between TP1 (HI) and TP2 (LO); it should be 10.5V ±0.1V.

d. Connect the voltmeter HI input lead to TP6 and the LO input lead to TP1 on the Basic PCB.

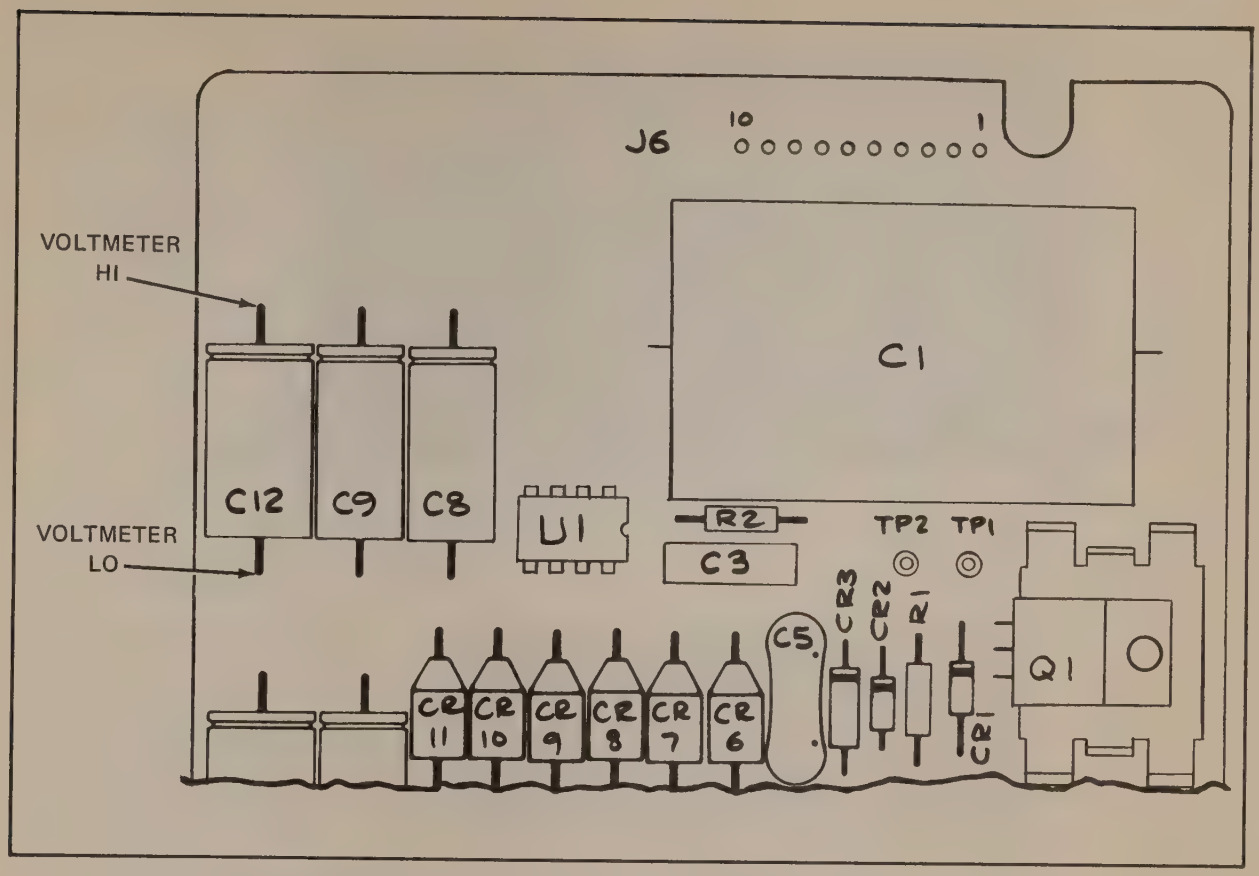


Figure 4-1. TEST EQUIPMENT CONNECTION FOR POWER SUPPLY ADJUSTMENT

e. Adjust the –6.2V ADJ (access through the rear panel) for an indication of -6.2000V ± 100 μV.

4-20. Zero Adjustment

4-21. Perform the zero adjustment on the 2100A as follows:

a. Insure that the 2100A GD and LO terminals are jumpered together.

b. Short the HI and LO INPUT together.

NOTE

Select the 40 mV range when adjusting zero on the 2100A–06 instrument.

c. Adjust the ZERO ADJ (R51) until the 2100A readout display is 00.0 and the minus polarity indication just flashes on and off.

d. Remove the short from between the HI and LO terminals

4-22. Equipment Preparation for Calibration

4-23. The reference junction compensation circuit and the linearizer circuit must be inactivated for the following test. The following procedure describes how to prepare the 2100A for calibration. The jumpers removed in this procedure will be reinstalled later.

a. Remove the retainer screws from the rear panel and slide the chassis out about four inches.

b. Remove the LIN and REF JCT jumpers. They are located near the left rear corner of the Basic PCB, (see Figure 4-2).

c. Connect the 2100A to the proper input power source.

4-24. The following procedure requires the test equipment to be prepared as follows:

a. Connect the test equipment as shown in Figure 4-3.

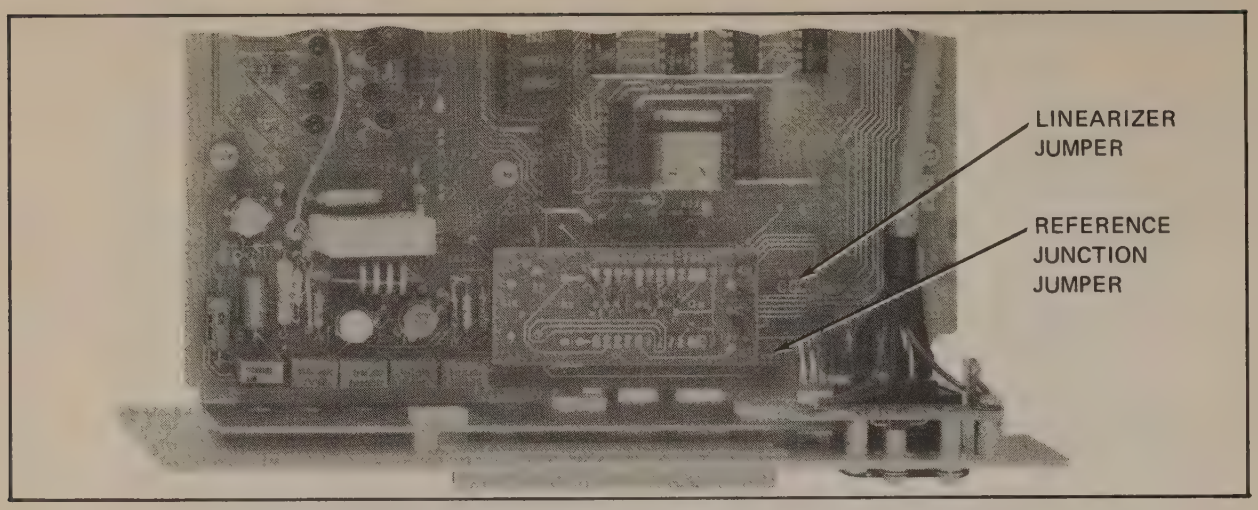


Figure 4-2. LINEARIZER AND REFERENCE JUNCTION JUMPER LOCATIONS.

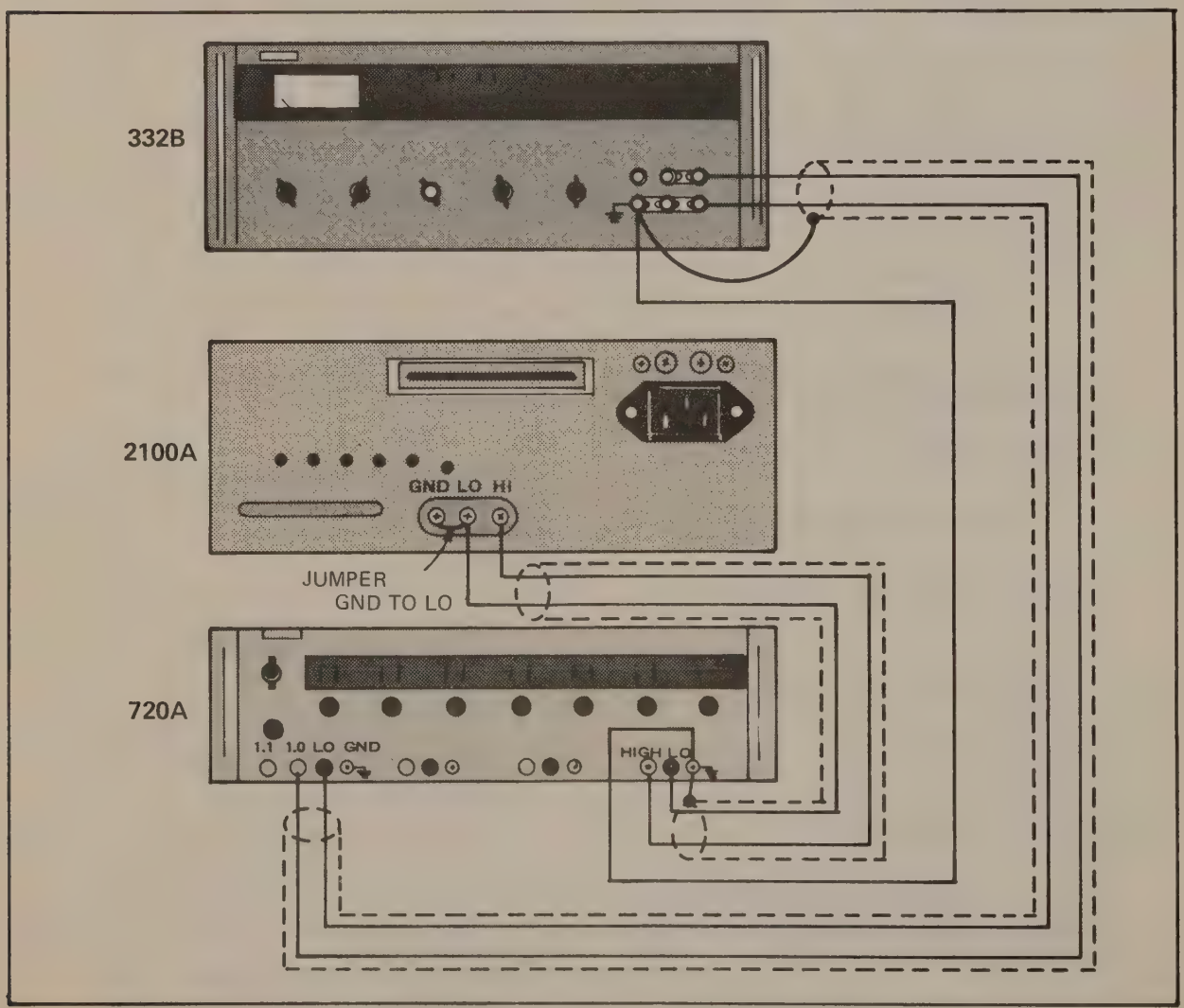


Figure 4-3. CALIBRATION EQUIPMENT CONNECTION

NOTE

Use a shielded pair of copper conductor wires for these connections. Insure that the connections to the 2100A input are tight; loose connections may introduct errors in the calibration. (Do not use aligator clips!) The jumper between the 2100A LO and GD terminals must be installed.

b. Connect a 0.47 microfarad (mylar or polystyrene) capacitor across the voltage divider output terminals (hight to low).

c. Turn the dc voltage calibrator and the 2100A on and allow 30 minutes for the instruments to warm-up.

4-25. Comparator Adjustment (COMP ADJ)

4-26. The input voltage level required depends on the type of thermocouple used. Adjust the controls of the voltage divider to provide a 1000: 1 division ratio. Then adjust the dc voltage calibrator output to obtain the correct input voltage to the 2100A. Table 4-2 provides the required input for each thermocouple type, the required 2100A display, and the tolerance limits for the display. Use the following procedure to make the adjustment.

NOTE

Short the 2100A input and check the display for 00.0 ±1 digit. If the display is not within ±1 digit recheck Zero Adjustment.

a. Apply the negative input, indicated in Table 4-2, that corresponds to the thermocouple type in use. (For the 2100A–06, use the 40 mV range for this adjustment.) (For R or S type, use positive polarity only.)

b. Adjust the COMP ADJ (R50) for a 2100A display within the limits specified.

c. Change the input to positive, as indicated in Table 4-2, and check for a display within the limits listed. If not, adjust the ZERO ADJ (R51) then repeat steps (a) and (b).

d. Remove the dc voltage from the 2100A input and short the HI and LO terminals together.

e. Check for a 2100A display of 00.0 ±1 digit (for the 2100A–06, check on the 40 mv range).

Table 4-2. COMPARATOR CALIBRATION

THERMO-COUPLE TYPE	2100A		
	INPUT	DISPLAY	LIMITS
J°F	+15.5uV	00.6	±1 digit
J°F	−15.5uV	−01.2	±1 digit
K°F	+11.5uV	00.6	±1 digit
K°F	−11.5uV	−01.2	±1 digit
T°F	+11.5uV	00.6	±1 digit
T°F	−11.5uV	−01.2	±1 digit
E°F	+20.0uV	00.6	±1 digit
E°F	−20.0uV	−01.2	±1 digit
R°F	+ 3.4uV	00.6	±1 digit
S°F	+ 3.4uV	00.6	±1 digit
J°C	+30.0uV	00.6	±1 digit
J°C	−30.0uV	−01.2	±1 digit
K°C	+20.0uV	00.6	±1 digit
K°C	−20.0uV	−01.2	±1 digit
T°C	+20.0uV	00.6	±1 digit
T°C	−20.0uV	−01.2	±1 digit
E°C	+30.0uV	00.6	±1 digit
E°C	−30.0uV	−01.2	±1 digit
R°C	+ 3.4uV	00.6	±1 digit
S°C	+ 3.4uV	00.6	±1 digit
40mV	+ 6.2uV	0.006	±1 digit
40mV	− 6.2uV	−0.006	±1 digit
400 mV	+62.0uV	0.06	±1 digit
400 mV	−62.0uV	−0.06	±1 digit

4-27. Positive Full Scale Adjustment (POS CAL)

NOTE

Calibration procedures contained in paragraphs 4-27 through 4-30 may be omitted during routine calibration. These procedures should, however, be done after the instrument has been repaired or when improper instrument operation is suspected.

4-28. Refer to Figure 4-3 for the correct calibration equipment connections for this procedure. Table 4-3 provides the value of the inputs required for each thermocouple type.

a. Apply the positive input, corresponding to the thermocouple type used, to the 2100A INPUT terminals (See Table 4-3).

b. Adjust POS. CAL. for a display within the tolerance limits specified in Table 4-3. (For the 2100A–06, adjust for each type and voltage range.)

Table 4-3. POSITIVE FULL SCALE INPUTS

THERMOCOUPLE TYPE	2100A INPUT	2100A DISPLAY	ADJUSTMENT LIMITS
J°F	+42.919mV	1716.7	±1 digit
K°F	+53.633mV	2896.2	±1 digit
T°F	+20.868mV	1126.8	±1 digit
E°F	+77.712mV	2564.5	±1 digit
R°F	+20.917mV	3765.0	±1 digit
S°F	+18.553mV	3339.6	±1 digit
J°C	+42.919mV	901.3	±1 digit
K°C	+55.833mV	1675.0	±1 digit
T°C	+20.868mV	646.9	±1 digit
E°C	+73.355mV	1467.1	±1 digit
R°C	+21.096mV	3797.3	±1 digit
S°C	+18.704mV	3366.8	±1 digit
40mV	+39.000mV	39.000	±1 digit
400mV	+390.00mV	390.00	±1 digit

4-29. Negative Full Scale Adjustment (NEG CAL)

4-30. Refer to Figure 4-3 for the correct calibration equipment connections for this procedure. Table 4-4 provides the value of the inputs required for each thermocouple type.

a. Apply the negative input, corresponding to the thermocouple type used, to the 2100A INPUT terminals.

b. Adjust NEG. CAL. for a display within the tolerance limits indicated in Table 4-4.

NOTE

For the 2100A–06, select the K type select switch for this adjustment, then check the J, T, and E types. If the display is out of tolerance, recheck Positive Full Scale Adjustment. Adjust –40 and –400 for the corresponding millivolt range.

Table 4-4. NEGATIVE FULL SCALE INPUTS

THERMOCOUPLE TYPE	2100A INPUT	2100A DISPLAY	ADJUSTMENT OR VERIFICATION LIMITS
J°F	–6.907mV	–552.6	±1 digit
K°F	–4.859mV	–524.8	±1 digit
T°F	–4.859mV	–524.8	±1 digit
E°F	–7.686mV	–507.3	±1 digit
J°C	–6.907mV	–290.1	±1 digit
K°C	–5.606mV	–336.4	±1 digit
T°C	–5.606mV	–347.6	±1 digit
E°C	–7.686mV	–307.5	±1 digit
40mV	–39.000mV	–39.000	±1 digit
400mV	–390.00mV	–390.00	±1 digit

4-31. Linearized Gain Check

4-32. The following procedure must be done with the linearizer jumper installed. A step-by-step installation procedure for the jumper is provided. Table 4-5 lists the inputs required for each thermocouple type and voltage range. Refer to Figure 4-3 for the correct calibration equipment connections for this procedure.

a. Unplug the line power cord from the 2100A.

b. Remove the chassis retainer screws and slide the chassis out of the case about three inches.

c. Plug the linearizer jumper into the Main PCB (See Figure 4-2).

d. Slide the chassis back into the case and secure it with one screw.

e. Short the INPUT HI and LO terminals together and verify that the display reads 00.0 ±1 digit.

f. Apply the positive and negative inputs, corresponding to the thermocouple type used, indicated in Table 4-5.

g. If paragraphs 4-27 through 4-30 have been skipped, adjust POS. CAL. for a display within the verification limits indicated in Table 4-5. (For the 2100A-06, adjust for each type.)

Table 4-5. LINEARIZED GAIN CHECK

THERMO-COUPLE TYPE	2100A		VERIFI-CATION LIMITS
	INPUT	DISPLAY	
J°F	+42.919mV	1374.9	±1 digit
K°F	+53.633mV	2400.00	±1 digit
T°F	+20.868mV	732.3	±1 digit
E°F	+77.712mV	1840.0	±1 digit
R°F	+20.917mV	3175.0	±3 digit
S°F	+18.553mV	3175.0	±3 digit
J°C	+42.919mV	760.0	±1 digit
K°C	+55.833mV	1400.0	±1 digit
T°C	+20.868mV	400.0	±1 digit
E°C	+73.355mV	960.0	±1 digit
R°C	+21.096mV	1767.0	±1 digit
S°C	+18.704mV	1768.0	±1 digit
J°F	−6.907mV	−320.0	±1 digit
K°F	−4.859mV	−292.2	±1 digit
T°F	−4.859mV	−320.0	±1 digit
E°F	−7.686mV	−320.0	
J°C	−6.907mV	−162.8	±1 digit
K°C	−5.606mV	−183.0	±1 digit
T°C	−5.606mV	−200.0	±1 digit
E°C	−7.686mV	−161.5	±1 digit

4-33. Open Input Detector Circuit Check

4-34. The 2100A provides a display indication of an open input; i.e., nothing attached to the HI and LO INPUT terminals or an open thermocouple. The following procedure will verify the proper operation of this circuit.

a. Connect a 1k ±5% resistor between the HI and LO INPUT terminals. (For the 2100A–10, select the POINT select switch corresponding to the location of the attached resistor.)

b. The 2100A display should indicate 00.0 ±1 digit.

c. Replace the 1k resistor with a 2k ±5% resistor.

d. The 2100A display should now be blank except for the decimal point and possibly the minus polarity sign.

4-35. Reference Junction Calibration

4-36. REFERENCE JUNCTION JUMPER INSTALLATION

4-37. The reference junction jumper must be installed for the following adjustment procedure. Use the following procedure to install the jumper.

a. Unplug the line cord from the 2100A.

b. Remove the rear panel retaining screws and slide the chassis out of the case about three inches.

c. Plug the reference junction jumper into the Basic PCB (see Figure 4-2 for jumper location).

4-38. TEST EQUIPMENT CONNECTION

NOTE

Calibration procedures contained in paragraph 4-39 step (a) through (k) may be omitted during routine calibration. These steps must be done if U32 is replaced during repair of the instrument.

4-39. The following method of connecting the test equipment to the 2100A is recommended to reduce the possibility of damage to the 2100A caused by inadvertant shorting together of J1A and J1B signals. If an alternate method is used to make the required connections, use extreme care to prevent inadvertant shorting together of terminals of J1A or J1B, other than those required for the procedure. Connect the test equipment as described in the following procedure.

a. Remove the center encircled screw from the lower half of the rear panel.

b. Remove the lower half of the rear panel, (2100A–03 or –06.) Use care when disconnecting the flat cable connection from J5 on the Basic PCB. For the 2100A–10, remove the pcb and unplug the interconnect cable.

CAUTION

Because of the possibility of damage to the contacts of J5, caused by incorrect connector diameter, the external connections should be made to a flat cable connector (J.F. Part No. 376285). The flat cable connector can then be plugged into J5 on the Basic PCB. Refer to Figure 4-4 for a description of the connections.

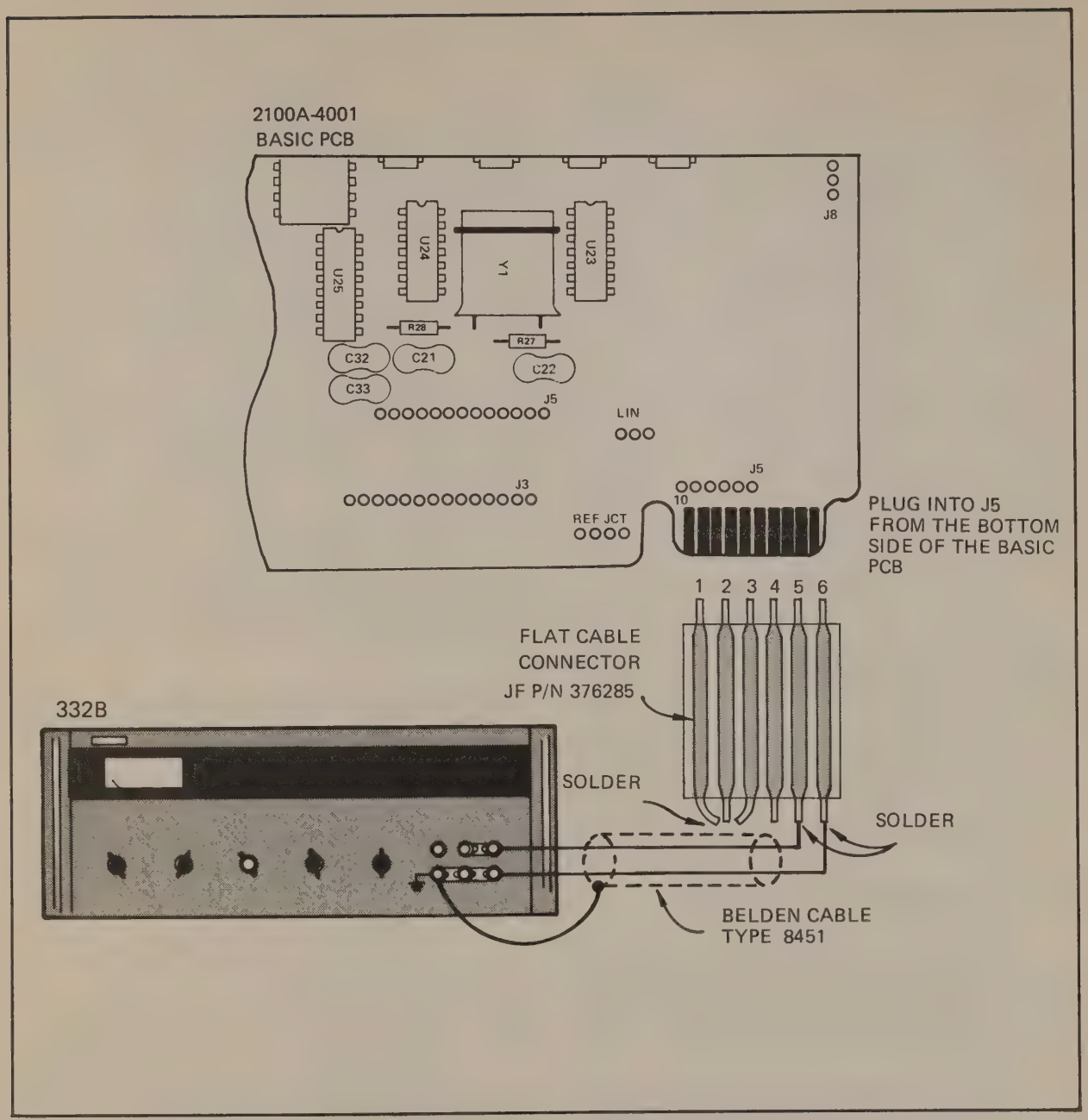


Figure 4-4. TEST EQUIPMENT CONNECTION FOR REFERENCE JUNCTION ADJUSTMENT

c. Slide the chassis back into the case and secure it with one screw. (Insure that the test equipment input is not shorted to the 2100A case.)

d. Attach the line cord to the 2100A and press the POWER switch to the on position.

e. Apply −540.0mV through the flat cable connector, power supply low output to J5 pin 6 and power supply high output to J5 pin 5.

f. Adjust REF JCT (R52) for a 2100A display (see Table 4-6) corresponding to the thermocouple type installed (2100A−03 and −10). For the 2100A−06 the REF JCT adjustment (R52) adjusts for the J type thermocouple. Adjustments R39, R40, R41, R42, and R43 on the Multi-Type PCB adjust for the K type, T type, E type, R type, and S type respectively. Select each type and adjust the display to within the tolerances given in Table 4-6.

Table 4-6. REFERENCE JUNCTION ADJUSTMENT LIMITS

THERMO-COUPLE TYPE	2100A		LIMITS
	INPUT	DISPLAY	
J°F	–540.0mV	77.0	± .05
K°F	–540.0mV	77.0	± .05
T°F	–540.0mV	77.1	± .05
E°F	–540.0mV	77.1	± .05
R°F	–540.0mV	77.0	*
S°F	–540.0mV	76.8/77.0	**
J°C	–540.0mV	24.9	± .05
K°C	–540.0mV	25.0	± .05
T°C	–540.0mV	25.0	± .05
E°C	–540.0mV	25.0	± .05
R°C	–540.0mV	24.9/25.0	**
S°C	–540.0mV	25.0	± .05

* The display may momentarily indicate ± .2

* * The display should alternate between the two indicated values; displaying each about half of the time.

g. Remove the test equipment connections from the 2100A.

h. Remove the reference junction jumper and replace the lower half of the rear panel (2100–03 or –06). For the 2100A–10, replace the Multi-Point PCB.

i. Short the 2100A INPUT HI and LO terminals together (use shorting bars). (Insure that the GD and LO terminals are connected together.)

j. Check 2100A display for 00.0 ±1 digit; if needed adjust ZERO ADJ (R51). For the 2100A–06, select the 40 mV range for the zero adjustment.

k. Remove the short from between the HI and LO INPUT terminals. (Insure that the LO and GD terminals are connected together and reinstall the REF JCT jumper.)

l. Connect the appropriate thermocouple to the HI and LO INPUT terminals (thermocouple wire with red insulation connects to LO). Use a J type thermocouple for the 2100A–06.

m. Insert a calibrated mercury-in-glass thermometer (PRINCO ASTM - 56C) and the thermocouple into a lag bath to a depth of four inches. Allow at least 20 minutes for the temperature to stabilize.

NOTE

A lag bath consists of a Dewar flask (vacuum bottle) filled with water at room temperature.

n. Slide the chassis out of the 2100A case about three inches and locate adjustment R3. (On the 2100A–03 and –06, R3 is located just on the inside of the lower half of the rear panel; on the –10, it is located just ahead of the INPUT terminals on the Multi-Point PCB.

o. Adjust R3 for a 2100A display indication, as corrected by Table 4-7, corresponding to the actual temperature indicated on the calibration thermometer.

Table 4-7. REFERENCE JUNCTION ADJUSTMENT CORRECTIONS

THERMO-COUPLE TYPE	
JF, KF, TF, EF, RF, SF	Adjust to read actual temperature
JC	Adjust to read actual temperature
KC	Adjust to read 0.1°C lower than actual temperature.
TC	Adjust to read actual temperature.
EC	Adjust to read actual temperature
RC	Adjust to read 0.1°C lower than actual temperature.
SC	Adjust to read 0.1°C lower than actual temperature.

4-40. TROUBLESHOOTING

4-41. The following information is designed to aid in troubleshooting the 2100A instruments. The information presented in Table 4-8 provides procedural steps for locating the problem area within the 2100A. Some steps in the proceudre require a decision, either yes or no, the answer to which indicates the next step to be completed. Possible causes for an incorrect response to the tests are provided.

4-42. Instructions for using the troubleshooting guide are as follows:

a. Read the instruction in step 1 and make the yes or no decision.

b. Refer to the column to the right of the step 1 instructions and proceed to the step corresponding to the decision.

c. Execute the instructions in the indicated next step.

NOTE

When an instruction suggests corrective action, locate and correct the fault before proceeding to the next step.

4-43. Replacement of CMOS or PMOS integrated circuits require special handling to prevent damage from static discharge through the devices. These integrated circuits are packaged in conductive foam when shipped and should not be removed until the time of installation. The repair personnel and the work surface should be commonly grounded.

4-44. . Use caution when handling any of the following integrated circuits:

On the Basic PCB – U1 thru U4, U6, U7, U22, or U25.

On the DOU PCB - All integrated circuits.

Table 4-8. TROUBLESHOOTING GUIDE

STEP	INSTRUCTION	YES	NO	GO TO
1	Is the line cord plugged in?	3	2	
2	Plug the line cord in.			3
3	Turn the POWER switch on.			4
4	Do the digits and the decimal point of the display light?	19	5	
5	Does only the decimal point light?	6	8	
6	Is the thermocouple input open?	7	8	
7	Connect a thermocouple or shorting bar between the HI and LO terminals.			4
8	Is the voltage level across J12 pin 20 (LO) and J12 pin 16 (HI) between +150 volts and +190 volts?	12	9	
9	Is the line power fuse F1 good?	11	10	
10	Replace the fuse			4
11	Troubleshoot the power supply			4
12	Check the display group containing DS1, DS2, and DS3:			
	If defective, replace the group.			4
	If not defective.			13
13	Is there a 1 MHz TTL square wave at U16 pin 3?	15	14	
14	Troubleshoot the 1 MHz oscillator U25 and Y1			4
15	(Remove the Linearizer jumper). Is there a 1 MHz TTL square wave at U17 pin 6?	16	17	

Table 4-8. TROUBLESHOOTING GUIDE (Cont.)

STEP	INSTRUCTION	YES	NO	GO TO
16	Replace U1 (Basic PCB).			4
17	Check U17 (Basic PCB).			4
18	Check U1 on the Display PCB and U2, U3, U4, U6, U7, and Q1 on the Basic PCB.			4
19	Perform the operational evaluation as described in paragraph 4-13.			20
20	Does the 2100A display indicate the temperature correctly?	21	22	
21	Perform the calibration procedure as described in paragraphs 4-16 through 4-37. *NOTE* *The results of the calibration procedure may point out some fault areas.*			
22	With the Linearizer jumper removed, attach test equipment as described in paragraph 4-36, to provide a −540 mV input to the 2100A.			23
23	Connect an oscilloscope to TP5. Is the signal similar to wave form A in Figure 4-5?	25	24	
24	Connect the oscilloscope to TP4. Is the signal similar to waveform B in Figure 4-5?	27	26	
25	Replace integrated circuit U1 on the Basic PCB			19
26	Use an oscilloscope to check for correct control signals as follows:			
	Connect the scope input to the collector of Q2; Is the signal similar to waveform C?	28	29, 32	
	Connect the scope input to the collector of Q4; Is the signal similar to waveform D?	28	30, 32	
	Connect the scope input to the collector of Q6; Is the signal similar to waveform E?	28	31, 32	
27	Troubleshoot U28, U29, and associated circuitry.			19
28	Troubleshoot U30 and associated circuitry.			19
29	Check for defective Q2, Q16, or U1.			19
30	Check for defective Q4, Q11, Q19, or U1			19
31	Check for defective Q6, Q12, or U1			19
32	Check for the correct reference voltage as described in paragraph 4-19, section d and e.			19

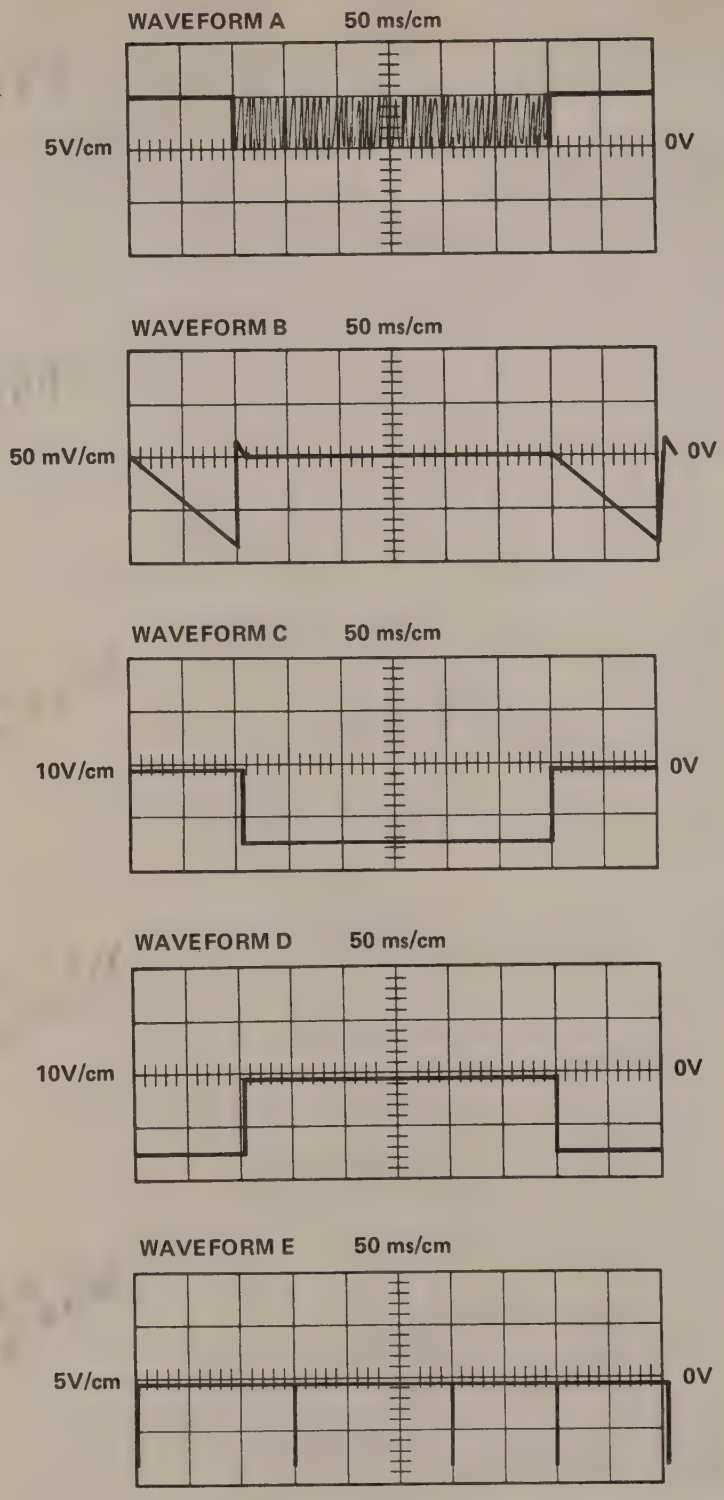


Figure 4-5. TROUBLESHOOTING WAVEFORMS

Section 5

Lists of Replaceable Parts

REFERENCE DESIGNATOR	ASSEMBLY NAME	PAGE
	Basic Unit Assembly (2100A)	5-4
A1	Basic PCB Assembly	5-8
A2	Display PCB Assembly	5-15
A4	Power Supply PCB Assembly	5-17
	Single Point Configuration (2100A–03)	5-19
A3	Single Type PCB Assembly	5-19
	Multi-Type Configuration (2100A–06)	5-24
A5	Type Select PCB Assembly °C	5-26
A5	Type Select PCB Assembly °F	5-30
	Multi-Point Configuration (2100A–10)	5-34
A6	Point Select PCB Assembly	5-35
	Battery Power Supply (2100A–01)	5-37
A7	Battery Charge PCB Assembly	5-38
A8	Digital Output Unit PCB Assembly (2100A-02)	5-39
	Analog Output Unit (2100A-04)	5-42

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number.

b. Description of each part.

c. Fluke Stock Number.

d. Federal Supply Code for Manufacturers. (See Appendix A for Code-to-Name list.)

e. Manufacturer's part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluek Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation or Item Number.

e. Printed Circuit Board Part Number.

f. Instrument model and Serial number.

2100A FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	2100A FINAL ASSEMBLY						
	Basic Unit Assembly	2100A					
	Single Point Configuration	2100A–03					
	Multi-Type Configuration	2100A–06					
	Multi-Point Configuration	2100A–10					
	Battery Power Supply	2100A–01					
	Digital Output Unit	2100A–02					
	Analog Output Unit	2100A-04					

BASIC UNIT ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	BASIC UNIT ASSEMBLY **Figure 5-1**	2100A					
A1	Basic PCB Assembly (Figure 5-2)	372383	89536	372383	1		
A2	Display PCB Assembly (Figure 5-3)	368134	89536	368134	1		
A4	Power Supply PCB Assembly (Figure 5-4)	371534	89536	371534	1		
F1	Fuse, slo-blo, ¼A	166306	71400	MDL	1		
S1	Switch, power	380303	89536	380303	1		
T1	Xfmr, power, 100V (not shown)	397257	89536	397257	1		
T1	Xfmr, power, 115V (not shown)	395582	89536	395582	1		
T1	Xfmr, power, 230V (not shown)	396465	89536	396465	1		
1	Cable Assembly, power	377820	89536	377820	1		
2	Chassis, guard	372276	89536	372276	1		
3	Chassis, side	372284	89536	372284	2		
4	Contact, spring	375360	89536	375360	1		
5	Cover, bottom	372292	89536	372292	1		
6	Cover, top	372300	89536	372300	1		
7	Decal, knob	285221	89536	285221	2		
8	Decal, side	381632	89536	381632	2		
9	Foot, bail stand	292870	89536	292870	4		
10	Frame, bezel	363093	89536	363093	2		
11	Guard, bottom	372235	89536	372235	1		
12	Guard, top	372318	89536	372318	1		
13	Handle, frame	310045	80536	310045	1		

BASIC UNIT ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
14	Handle grip	284836	89536	284836	2		
15	Insert, non-skid foot	302026	89536	302026	4		
16	Insulator, bottom guard	401083	89536	401083	1		
17	Insulator, fastener	372342	89536	372342	11		
18	Insulator, spacer	372334	89536	372334	11		
19	Knob, female	309054	80536	309054	2		
20	Knob, male	309047	89536	309047	2		
21	Panel Insert, DOU	373274	89536	373274	1		
22	Post, jack black	162073	74970	108-903	1		
23	Post, jack red	162065	74970	108-902	1		
24	Pushbutton, green	268862	71590	J61993	1		
25	Rear Panel, upper	372250	89536	327250	1		
26	Shield, display	372326	89536	372326	1		
27	Washer, spring	228981	89536	228981	2		

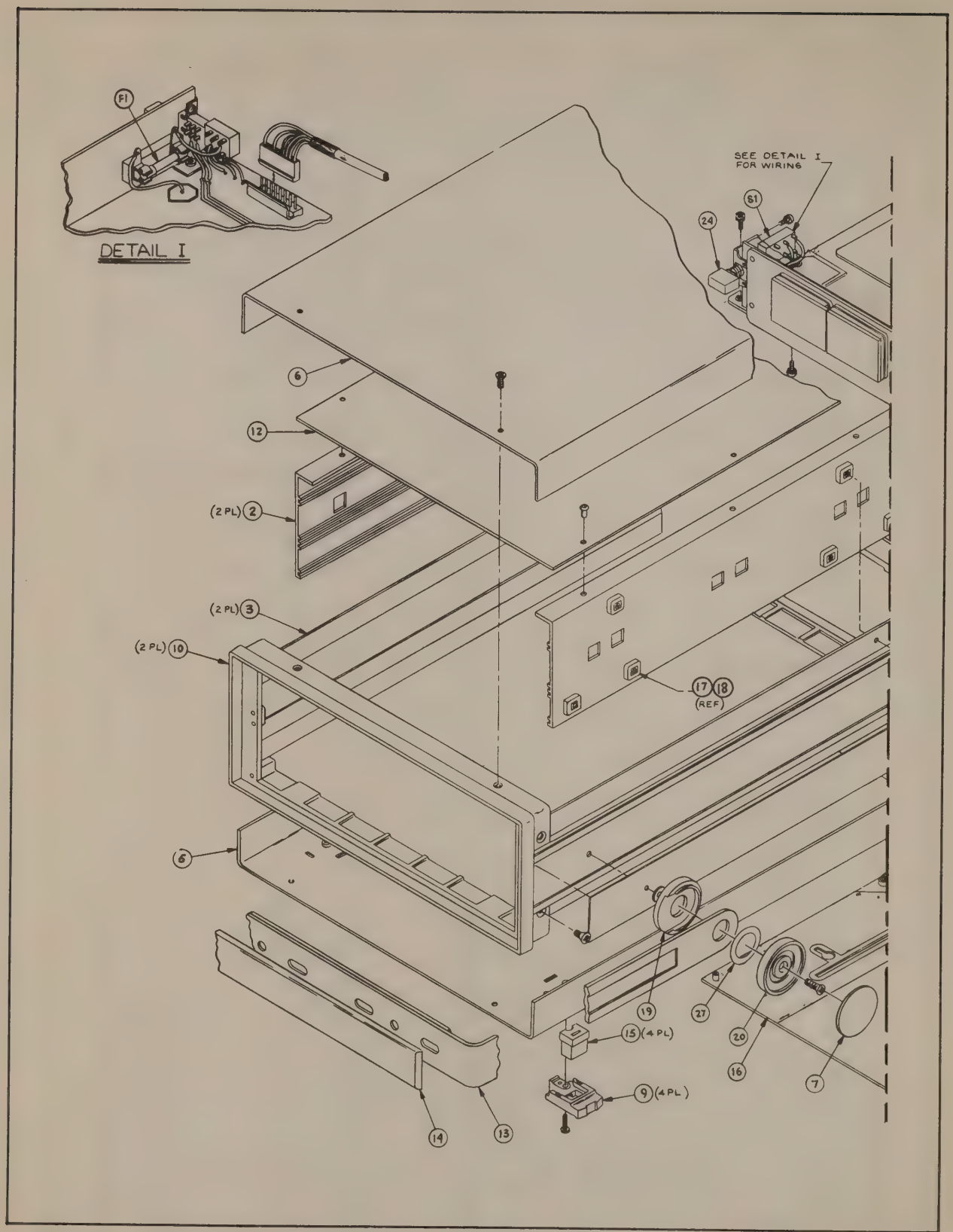


Figure 5-1. BASIC UNIT ASSEMBLY (sheet 1 of 2)

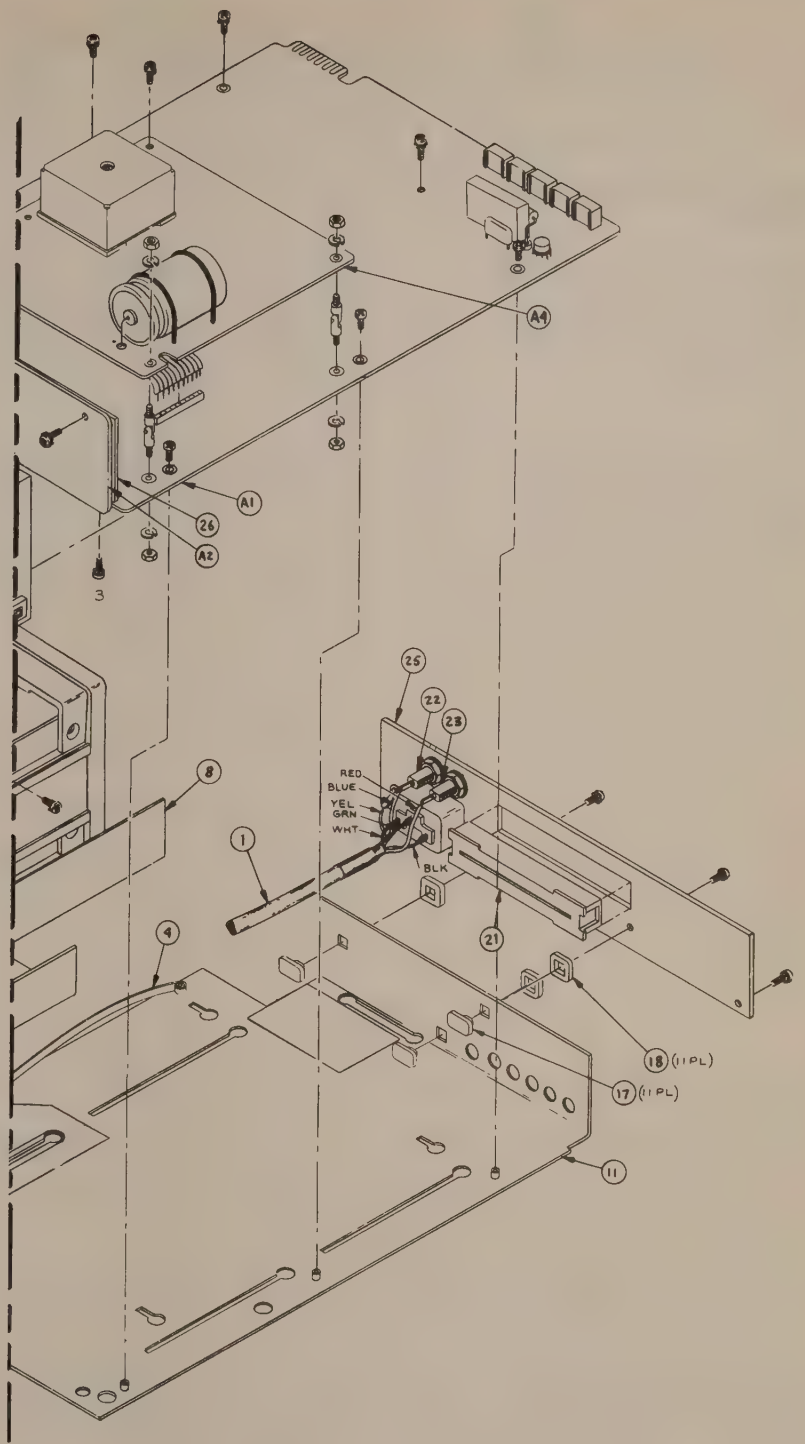


Figure 5-1. BASIC UNIT ASSEMBLY (sheet 2 of 2)

BASIC PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	**BASIC PCB ASSEMBLY** **Figure 5-2**	372383	89536	372383	REF		
C1	Cap, plstc, 0.022 uF ±10%, 250V	234484	73445	C220AE/A22K	1		
C2,C5-C8, C11, C13	Cap, Ta, 10 uF ±20%, 20V	330662	12954	D10GS820M	7		
C3	Cap, mica, 82 pF ±5%, 500V	148502	71236	DML5E820J	1		
C4	Cap, mica, 150 pF ±1%, 500V	226134	71236	DML5F151F	1		
C9,C19	Cap, plstc, 2.2uF ±10%, 250V	306522	25403	C280MCH/A2M2	2		
C10,C17	Cap, cer, 0.0012 uF ±10%, 500V	106732	71590	CF122	2		
C12	Cap, plstc, 0.47uF ±10%, 50V	363085	01281	JF86	1		
C14	Cap, mica, 330pF ±5%, 50V	148445	71236	DML5F331J	1		
C15,C16	Cap, mica, 470 pF ±5%, 500V	148429	71236	DM19F471J	2		
C18	Cap, met. poly carb, 0.10 uF ±10%, 400V	289744	25403	C280CF/A10K	1		
C20, C24, C25, C32, C33	Cap, mini, cer, 33pF ±2%	354852	80031	2222-638-10339	5		
C21	Cap, mica, 15pF ±5%, 500V	148569	71263	DM15F150J	1		
C22	Cap, mica, 68 pF ±5%, 500V	148510	71263	DM15F680J	1		
C23, C30, C31	Cap, mica, 100 pF ±1%, 500V	226126	71263	DM15F101F	3		
C34, C37	Cap, mica, 0.22 uF ±20%, 50V	309849	71590	CW30C224K	2		
C35	Cap, mica, 100 pF ±5%, 500V	148494	71263	DM15F101J	1		
C36	Cap, mini, cer, 150 pF ±2%, 100V	362764	80031	2222-638-34151	1		
CL1	Diode, fet,	348482	17856	E505	1		

BASIC PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR1	Diode, zener	113316	07910	1N748	1		
CR2 thru CR7, CR11, CR12, CR14, CR18	Diode, Si, Hi-speed switching	203323	07918	T08253	10		
CR8, CR10, CR13	Xstr, FED, N-channel	376475	12040	SP50072	9		
CR9	Diode, zener	159798	04713	1N751	1		
CR15, R45, R46	Zener, REF Set	377283	89536	377283	1		
CR16, CR17	Diode, Rect, Si	116111	05277	1N4817	2		
CR20	Diode, Rect, Si.	343491	04713	1N4002	1		
Q1 thru Q5, Q10	Xstr, Si, NPN	218396	04713	2N3904	6		
Q6	Xstr, Si, NPN	159855	07910	CS23030	1		
Q7	Xstr, power, Si, PNP	325753	03508	D45C5	1		
Q8	Xstr, Si, PNP	352369	04713	2N4403	1		
Q9	Xstr, Si, PNP	195974	04713	2N3906	1		
Q11, Q12, Q16, thru Q19	Xstr, FET, N-channel (See CR8)	376475	12040	SF50072	REF		

BASIC PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q13	Xstr, FET, selected	402024	89536	402024	1		
Q14, Q15	Xstr, FET, N-channel	288324	12040	SF50070	2		
R1, R4	Res, comp, 4.7k ±5%, ¼W	148072	01121	CB4725	2		
R2	Res, comp, 68k ±5%, ¼W	148171	01121	CB6835	1		
R3	Res, comp, 27k ±5%, ¼W	148148	01121	CB2735	1		
R5, R10	Res, comp 47k ±5%, ¼W	148163	01121	CB4735	2		
R6, R38	Res, comp, 100k ±5%, ¼W	148189	01121	CB1045	2		
R7, R8	Res, comp, 2.2k ±5%, ¼W	148049	01121	CB2225	2		
R9	Res, comp, 43k ±5%, ¼W	193367	01121	CB4335	1		
R11, R12, R16	Not used						
R13	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	1		
R14	Res, met flm, 332k ±1%, 1/8W	289504	91637	MFF1-83323F	1		
R15	Res, comp, 3m ±5%, ¼W	221952	01121	CB3055	1		
R17	Res, met flm, 49.9 ±1%, 1/8W	305896	91637	MFF1-849R9F	1		
R18	Res, comp, 3.3k ±5%, ¼W	148056	01121	CB3325	1		
R19	Not used						
R20, R26	Res, comp, 1.5k ±5%, ¼W	148031	01121	CB1525	2		
R21	Res, comp, 75 ±5%, ¼W	246736	01121	CB7505	1		
R22	Res, comp, 120k ±5%, ¼W	193458	01121	CB1245	1		

BASIC PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R23, R24, R25, R27, R34, R56, R58	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	7		
R28	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	1		
R29	Res, met flm, 30.6k ±1%, 1/8W	281121	01637	MFF1-88062F	1		
R30	Res, met flm, 182k ±1%, 1/8W	241091	91637	MFF1-81823F	1		
R31	Res, met flm, 402 ±1%, 1/8W	289611	91637	MFF1-84020F	1		
R32, R33	Res, met flm, 10.02k ±1%, 1/8W	352245	91637	MFF1-8-10-0210-1PCT	2		
R35	Res, comp, 300 ±5%, ¼W	348276	01121	CB3015	1		
R36	Res, comp, 16k ±5%, ¼W	221606	01121	CB1635	1		
R37	Res, fxd, sub-mini, 22, 1k, ±0.1%, ¼W	385500	54294	SP21D5102B	1		
R39	Res, met flm, 10 ±0.1%, 1/8W	375501	91637	MFF1-8100B	1		
R40	Res, comp, 10m ±5%, ¼W	194944	01121	CB1065	1		
R41	Res, comp, 33k ±5%, 2W	158964	01121	HB3335	1		
R42, R43	Res, matched set	412056	89536	412056	2		
R44	Res, met flm, 24.9k ±1%, 1/8W	290106	91637	MFF1-82492F	1		
R47	Res, met flm, 61.9k ±1%, 1/8W	237230	91637	MFF1-86192F	1		
R48	Res, sub-mini, ww, 20k ±0.1%, ¼W	385591	54294	SP21D5203B	1		
R49	Res, sub-mini, ww, 10k ±0.1%, ¼W	385534	54294	SP21D5103B	1		
R50, R51	Res, var, cer, 100k ±10%, ½W	288308	71450	360S104K	2		
R52	Res, var, cer, 50 ±10%, ½W	285122	71450	360S500A	1		
R53	Res, var, cer, 500 ±10%, ½W	291120	71450	360S501A	1		

BASIC PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R54	Res, var, cer, 100 ±10%, ½W	285130	71450	360S101A	1		
R57	Res, comp, 470k ±5%, ¼W	188441	01121	CB4745	1		
R60	Res, comp, 5.1m ±5%, ¼W	296467	01121	CB5155	1		
U1	IC, C-MOS, custom	354985	89536	354985			
U2,U3, U4	IC, C-MOS, quad, 2-input, NAND gate	355198	95303	CD4011AE	3		
U5,U10, U15	IC, Dual, JK master-slave Flip-Flop	293043	01295	SN74107N	3		
U6,U25	IC, COS-MOS, Hex, Buffer/Inverter	381848	95303	CD4049AE	2		
U7	IC, MOS, Dual "D" Type Flip-Flop	340117	04713	MC14013L	1		
U8	Res, network, 47k ±5%, ¼W	381996	56289	Type 916C	1		
U9,U16	IC, TTL, Hex Inverter	292979	01295	SN7404N	2		
U11	IC, TTL, Triple, 3-input positive NAND gate	292995	01295	SN7410N	1		
U12, U17	IC, TTL, Quad, 2-input NAND gate	292953	01295	SN7400N	2		
U13	IC, TTL,Quad, 2-input, positive AND gate	292987	01295	SN7408N	1		
U14, U18	IC, TTL, Quad, 2-input, positive NAND gate	292961	01295	SN7403N	2		
U19	IC, TTL, 5-Bit Shift Register	293399	01295	SN7496N	1		
U20	IC, TTL, 4-Bit Binary Counter	320739	01295	SN7493N	1		
U21	IC, TTL, MSI, Counter, Multiplier, 6-Bit Binary Rate	370692	01295	SN7497N	1		
U22	IC, ROM, for °C	370023	89536	370023	1		
	IC, ROM, for °F	370015	89536	370023	1		
U23	IC, TTL, Dual 4-input positive NAND Buffer	293001	01295	SN7420N	1		
U24	IC, TTL, Quad, 2-input positive OR gate	342709	01295	SN7432N	1		

BASIC PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U26	Res, network	375097	71450	TYPE 760	1		
U27, U33	IC, Op-Amp	271502	12040	LM 301A	2		
U28	IC, Voltage Comparator	352195	12040	LM311N-8	1		
U29	IC, Op-Amp, J-FET	357830	12040	LH0042C	1		
U30	IC, Op-Amp	284760	12040	LM308H	1		
U31, U32	IC, Op-Amp	225961	34333	SG-8023	2		
Y1	Crystal, 1 MHz	375493	75378	Type H17	1		
1	Connector, PCb	376384	27264	09-52-3101	1		
2	Socket, IC	376236	23880	TSA-3100-24W	1		
3	Socket, IC	376244	23880	TSA-3100-40W	1		
4	Socket	392944	00779	3-332070	9		

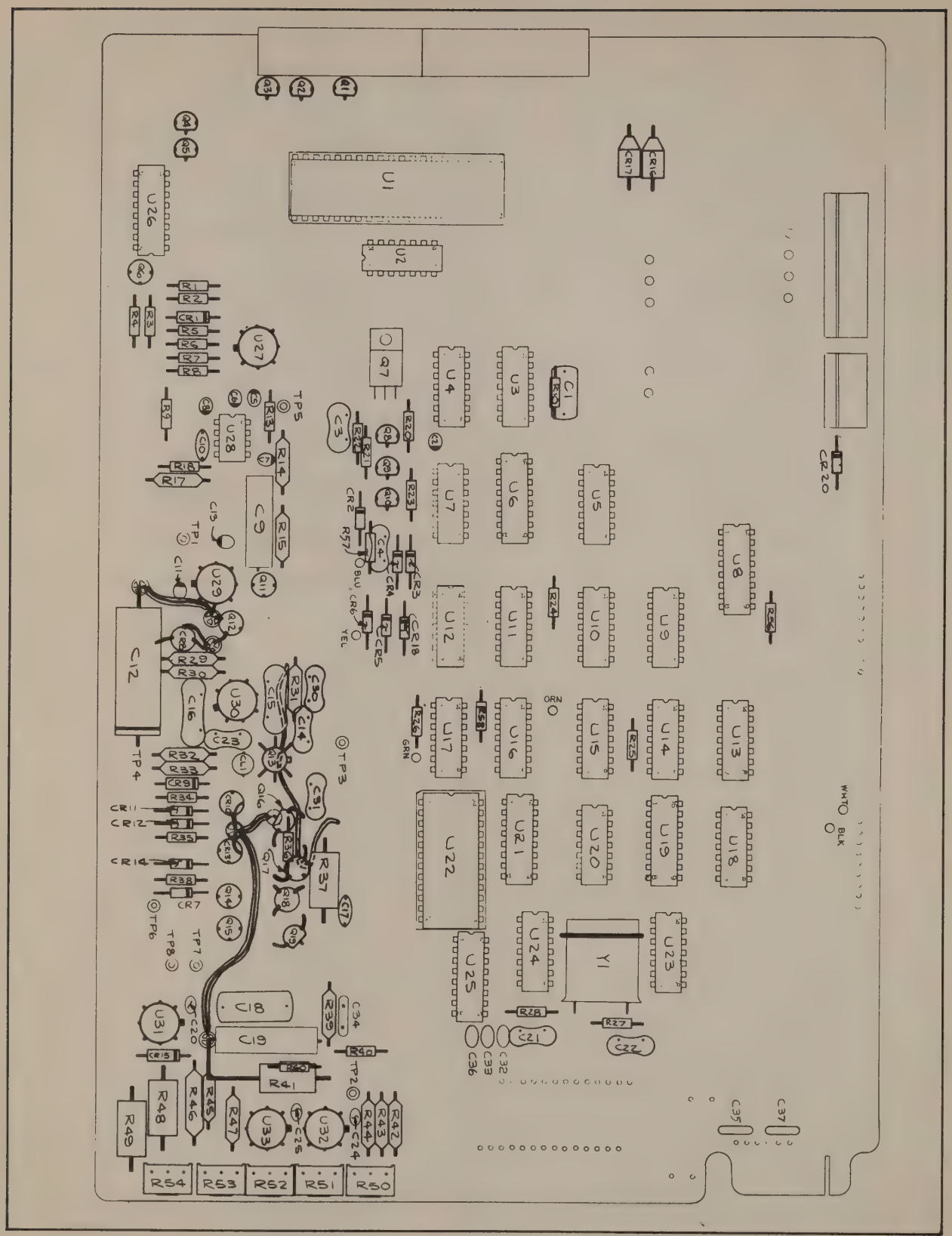


Figure 5-2. BASIC PCB ASSEMBLY

DISPLAY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	**DISPLAY PCB ASSEMBLY** **Figure 5-3**	368134	89536	368134	REF		
DS1, DS2, DS3	Display	370718	zzzzz	SP353	1		
DS4 DS5, DS6	Display	370726	zzzzz	SP354	1		
P1, P2	Conn, PCB Interconnect	376400	27264	-9-64-1101	2		
Q1 thru Q6	Xstr, Si, NPN	370684	04713	MPS A42	6		
Q7 thru Q12	Xstr, Si, PNP	266619	07263	PN4888	6		
Q15, Q16	Xstr, Si, NPN	245480	04713	ST 81011	2		
Q18	Xstr, Si, NPN	159855	07910	CS23030	1		
R3	Res, comp, 6.2k ±5%, ¼W	221911	01121	CB6225	1		
R4	Res, comp, 3.9k ±5%, ¼W	148064	01121	CB3925	1		
R5	Res, comp, 18k ±5%, ¼W	148122	01121	CB1835	1		
R6	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	1		
U1	IC, TTL, High Voltage, 7-segment Driver Decoder	330837	zzzzz *	DD700	1		
U2	Res, network, 16 peices	375089	11236	Type 760	1		
	Socket, IC	376202	zzzzz	CS353	2		

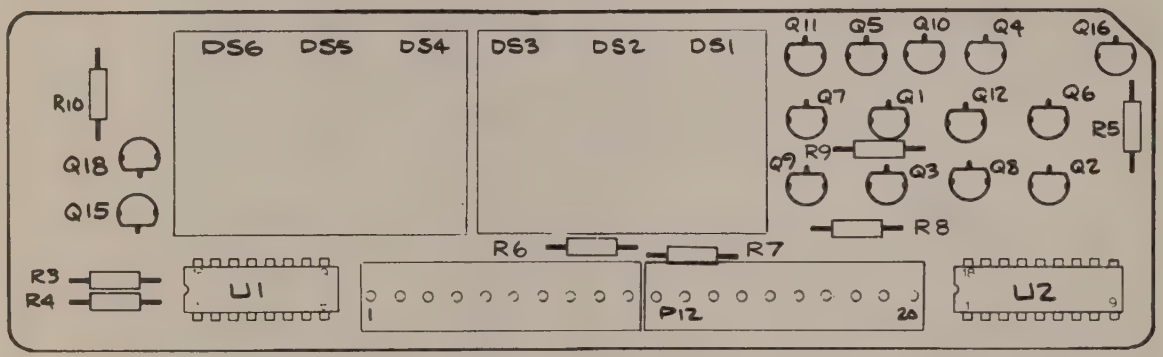


Figure 5-3. DISPLAY PCB ASSEMBLY

POWER SUPPLY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	**POWER SUPPLY PCB ASSEMBLY** Figure 5-4	371534	89536	371534	REF		
C1	Cap, elect, 4000 uF −10/+100%, 25V	370734	25088	B41010-2200115	1		
C2	Cap, fxd, poly-film, 0.01uF ±10%, 250V	325548	73445	C280AE/A10K	1		
C3	Cap, plstc, 0.022 uF ±10%, 250V	234484	73445	C280A+/A22K	1		
C4	Cap, plstc, 0.047 uF ± 250V	184366	73445	C280A+/A470K	1		
C5	Cap, mica, 1000 pF ±5%, 500V	148387	71236	DM19F102J	1		
C6	Cap, elect, 3 uF −10/+50%, 250V	306555	56289	500D305F250-DC7	1		
C7	Cap, elect, 150 uF - 10/+50%, 16V	186296	73445	ET151X016A5	1		
C8,C9	Cap, elect, 100 uF −10/+50%, 25V	192914	73415	ET101X025A5	2		
C12	Cap, elect, 470 uF −10/+50%, 6.3V	187773	73445	ET471X6P3A6	1		
C13	Cap, fxd, cer, 0.0012 uF ±10%, 500V	106732	71590	CF122	1		
CR1	Diode, zener, 6.8V	260695	07910	1N754A	1		
CR2	Diode, Si, 150 mA	203323	07910	TD8253	1		
CR3	Diode, zener	386557	07910	1N960B	1		
CR4	Diode, Si, 1 Amp 600 piv	112383	05277	1N4822	1		
CR5 thru CR11	Diode, Si, 1 Amp, 100 piv	116111	05277	1N4817	7		
Q1, Q4, Q5	Xstr, Si, PNP, pwr	325753	09214	D45C5	3		
Q2	Xstr, Si, PNP	352369	07263	2N4403	1		
Q3	Xstr, Si, PNP	195974	04713	2N3906	1		
R1	Res, comp, 47 ±5%, ¼W	147892	01121	CB4705	1		
R2	Res, comp, 680 ±5%, ¼W	148007	01121	CB6815	1		
R3, R7	Res, comp, 100 ±5%, ¼W	147926	01121	CB1015	2		
R4	Res, var, cermet, 200 ±10%, ½W	275743	71450	360%201A	1		

POWER SUPPLY PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R5, R6	Res, comp, 470 ±5%, ¼w	147983	01121	CB4715	2		
T1	Xfmr, Inverter	377929	89536	377929	1		
U1	IC, Linear Voltage Regulator	363861	49956	RC4195 DN	1		
	Cable, flex	376293	26394	100F40182A10	1		
	Heat sink	352765	13103	6107B14	1		
	Strap, rubber round	104794	98159	2829-115-3	1		

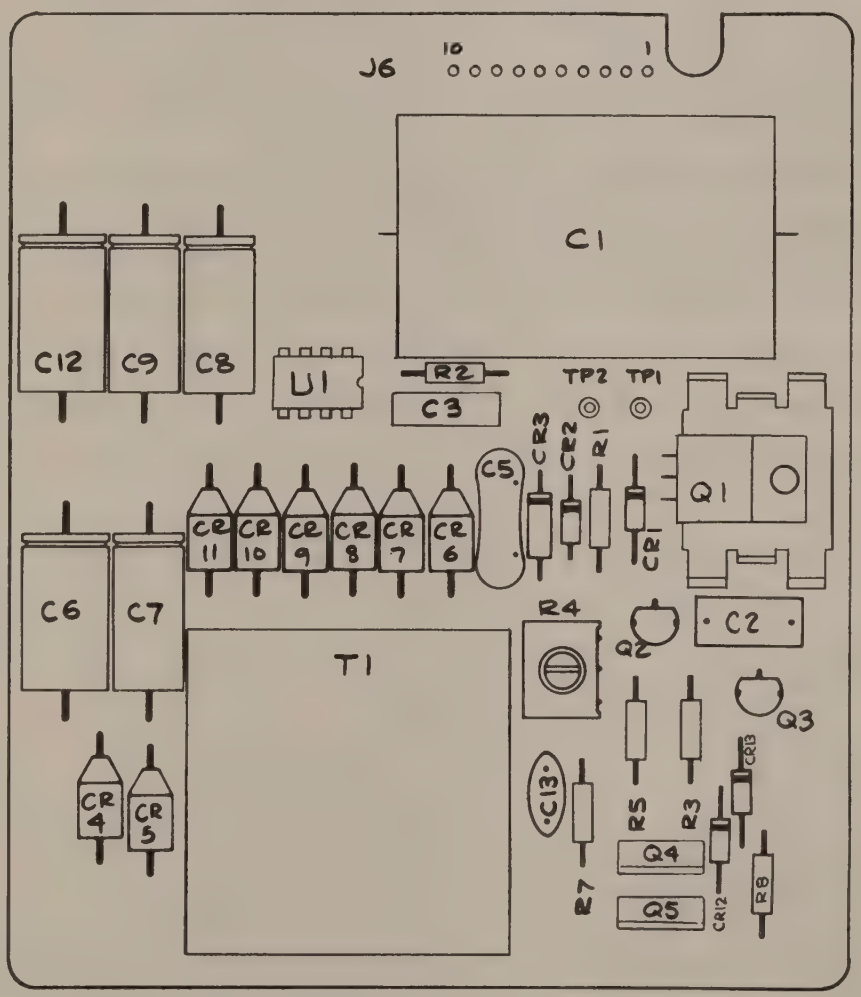


Figure 5-4. POWER SUPPLY PCB ASSEMBLY

SINGLE INPUT CONFIGURATION

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	SINGLE INPUT CONFIGURATION Figure 5-5	2100A-03					
1	Decal, AC Power, Front Panel	381152	89536	381152	1		
2	Decal, Front Panel Basic	380873	89536	380873	1		
3	Insert, Front Panel	372359	89536	372359	1		
4	Front Panel, Finished	397653	89536	397653	1		
5	Single Input PCB	405316	89536	405316	1		
A3	Single Type PCB Assembly Figure 5-6						
TYPE EC		415893	89536	415893			
R1	Res, var, 100 ±20%, ½W	278923	11236	190PC101B	1		
R2	Res, fxd, ww, sub-mini, 11.35k ± 0.1%	385542	54294	SP21DS - 113 50B	1		
R3	Res, met flm, 7.68k ±1%, 1/8W	370999	91637	MFF1-87R68F	1		
R4	Res, met flm, 37.01k ±0.1%, 1/8W	386425	91637	MFF1-837R01B	1		
R5	Res, met flm, 19.901k ±0.1%, 1/8W	386334	91637	MFF1-819R90B	1		
TYPE EF		415836	89536	415836			
R1	Res, var, 200 ±20%, ¼W	284711	11236	190PC 201B	1		
R2	Res, fxd, ww, sub-mini, 19.41k ±0.1%	385583	54294	SP21D5-19410B	1		
R3	Res, met flm, 12.4k ±1%, 1/8W	261644	91637	MFF1 - 812R4F	1		
R4	Res, met flm, 95.52k ±1%, 1/8W	386417	91637	MFF1-895R52B	1		
R5	Res, met flm, 19.90k ±0.1%	386334	91637	MFF1-819R90B	1		
TYPE JC		415836	89536	415836			
R1	Res, var, 100 ±20%, ½W	267823	11236	190PC 201B	1		
R2	Res, fxd, ww, sub-mini, 11.97k ±0.1%	385559	54294	SP105-11970B	1		
R3	Res, met flm. 8.06k ±1%, 1/8W	294942	91637	MFF1-88061F	1		
R4	Res, met flm, 44.563k ±0.1%, 1/8W	386367	91637	MFF1-8442563B	1		
R5	Res, met flm, 23.445k ±0.1%, 1/8W	386300	91637	MFF1-823R445B	1		
TYPE JF		415810	89536	415810			
R1	Res, var, 200 ±20%, ½W	284711	11236	190PC 201B	1		
R2	Res, fxd, ww, sub-mini, 23.78k ±0.1%	385609	54294	SP21D5- 237 80B	1		

SINGLE INPUT CONFIGURATION (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R3	Res, met flm 14.7k ±1%' 1/8W	226225	91637	MFF1-81471F	1		
R4	Res, met flm, 121k ±0.1%, 1/8W	370817	91637	MFF1-81213B	1		
R5	Res, met flm, 23.445 k ±0.1%, 1/8W	386300	91637	MFF1-823R 445B	1		
TYPE KC		415885	89536	415885			
R1	Res, var, 100 ±20%, ½W	267823	11236	190PC101B	1		
R2	Res, fxd, ww, sub-mini, 17.55k ±0.1%	385567	54294	SP21D5-12550B	1		
R3	Res, met flm, 11.5k ±1%, 1/8W	267138	91637	MFF1-81151F	1		
R4	Res, met flm, 55.947k ±0.1%, 1/8W	386383	91637	MFF1-855R942B	1		
R5	Res, met flm, 29.931k ±0.1%, 1/8W	386318	91632	MFF1-829R931B	1		
TYPE KF		415828	89536	415828			
R1	Res, var, 200 ±20%, ½W	284711	11236	190PC 201B	1		
R2	Res, fxd, ww, sub-mini, 32.38k ±0.1%	385617	54298	SP21D5=32380B	1		
R3	Res, met flm, 21k ±1%, 1/8W	229484	91637	MFF1-8213F	1		
R4	Res, met flm, 149.0k ±0.1% 1/8W	386375	91637	MMF1-814940B	1		
R5	Res, met flm, 29.931k ±0.1%, 1/8W	386318	91637	MFF1-8238931B	1		
TYPE RC		415901	89536	415901			
R1	Res, var, 1k ±20%, ½W	267856	11236	190PC102B	1		
R2	Res, fxd, ww, sub-mini, 110.09k ±01%	385633	54942	SP21D5-11DR 09B	1		
R3	Res, met flm, 71.5k ±1%, 1/8W	291435	91637	MFF1-87151F	1		
R4	Res, met flm, 368,9k ±0.1%, 1/8W	386441	91632	MFF1-8368 R9B	1		
R5	Res, met flm, 204.5k ±0.1%, 1/8W	393793	91637	MFF1-8204 R5B	1		

SINGLE INPUT CONFIGURATION (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
TYPE RF		415844	89536	415844			
R1	Res, var, 1k ±20%, ½W	267856	11236	190 PC 102 B	1		
R2	Res, fxd, ww, sub-mini, 110.09k ±0.1%	385633	54294	SP21D5-110R09B	1		
R3	Res, met flm, 71.5k ±1%, 1/8W	291435	91637	MFF1-871R5F	1		
R4	Res, met flm, 788.6k ±0.1%, 1/8W	386433	91637	MFF1-878886B	1		
R5	Res, met flm, 204.5 ±0.1%, 1/8W	393793	91637	MFF1-8204R5B	1		
TYPE SC		415919	89536	415919			
R1	Res, var, 1k ±20%'½W	267856	11236	190 PC 102B	1		
R2	Res, fxd, ww, sub-mini, +10.09k ±0.1%	385633	54294	SP21D5-110R09B	1		
R3	Res, met flm, 71.5k ±1%, 1/8W	291435	91637	MFF1-871R51F	1		
R4	Res, met flm, 366.7k ±0.1%, 1/8W	386466	91637	MFF1-836687B	1		
R5	Res, met flm, 202.6k ±0.1%, 1/8W	386342	91637	MFF1-8202R6B	1		
TYPE SF		415851	89536	415851			
R1	Res, var, 1k ±20%, ½W	267856	11236	190PC102B	1		
R2	Res, fxd, ww, sub-mini, 110.09k ±0.1%	385633	54294	SP21D5-110R09B	1		
R3	Res, met flm, 71.5k ±1%, 1/8W	291435	91637	MFF1- 87151F	1		
R4	Res, met flm, 799.5k ±0.1%, 1/8W	386458	91637	MFF1 -8799 R51B	1		
R5	Res, met flm, 202.6k ±0.1%, 1/8W	386342	91637	MFF1-8202 R6B	1		
TYPE TC		415869	89536	415869			
R1	Res, var, 100 ±20%, ½ W	267823	11236	190PC 101B	1		

SINGLE INPUT CONFIGURATION (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R2	Res. fxd, ww, sub-mini, 18.17k ±0.1%	385575	54298	SP21DS-18170B	1		
R3	Res, met flm. 11.5k ±0.5%, 1/8W	267138	91637	MFF1-81125D	1		
R4	Res, met flm. 55.09k ±0.1%, 1/8W	404038	91637	MFF1-855R09B	1		
R5	Res, met flm, 29.784k ±0.1%, 1/8W	386326	91637	MFF1-829R 784B	1		
TYPE TF		415802	80536	415802			
R1	Res, var, 200 ±20%, ½W	284711	11236	190PC201B	1		
R2	Res, fxd, ww, sub-mini, 32.38k ±0.1%	385617	54294	SP21D5-32380B	1		
R3	Res, met flm, 21k ±1%, 1/8W	229484	91637	MFF1-8212F	1		
R4	Res, met flm, 137.04k ±0.1%, 1/8W	404046	91637	MFF1-855R09B	1		
R5	Res, met flm, 29.784k ±0.1%, 1/8W	386326	91637	MFF1-829 R784B	1		

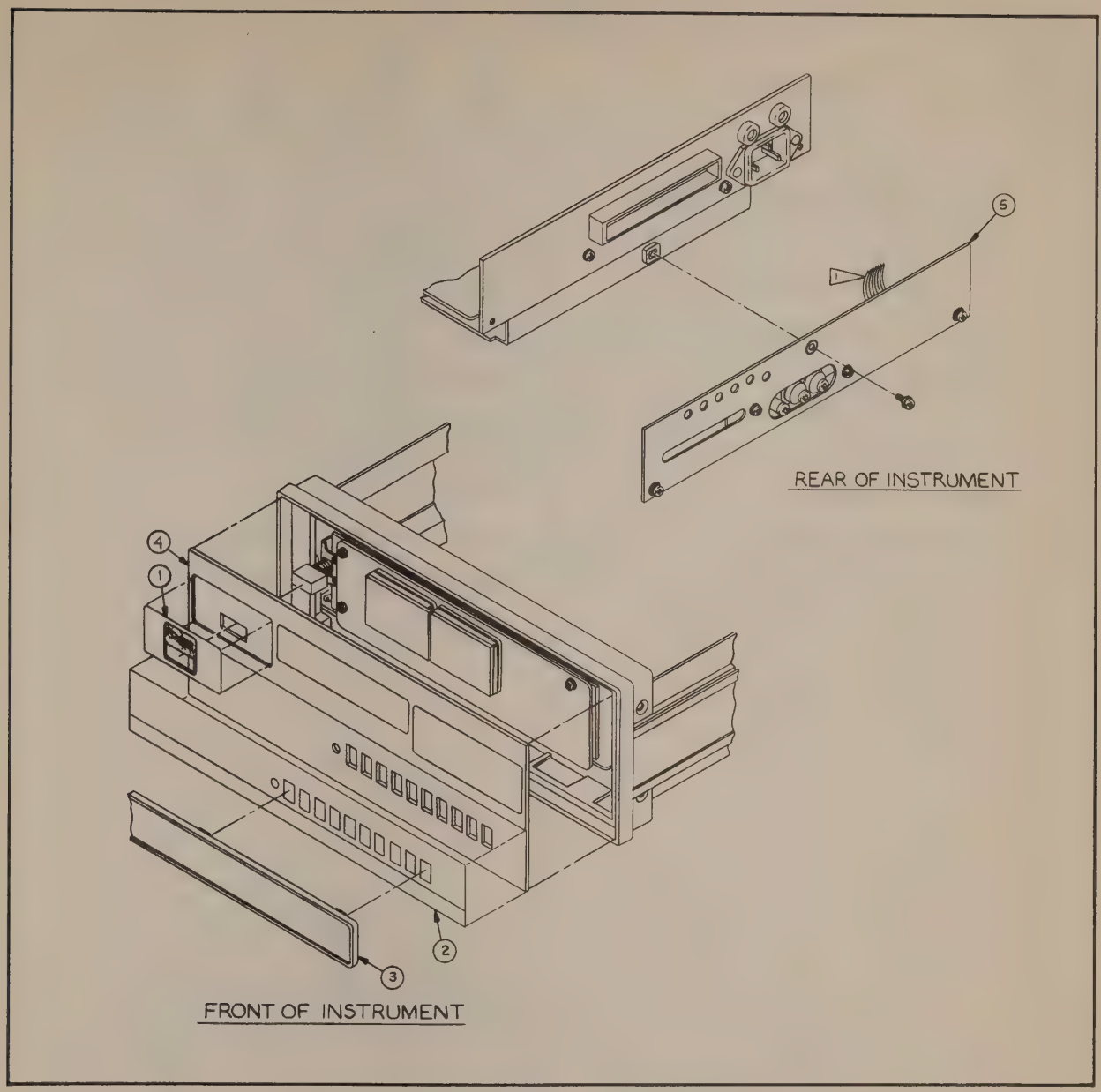


Figure 5-5. SINGLE INPUT CONFIGURATION

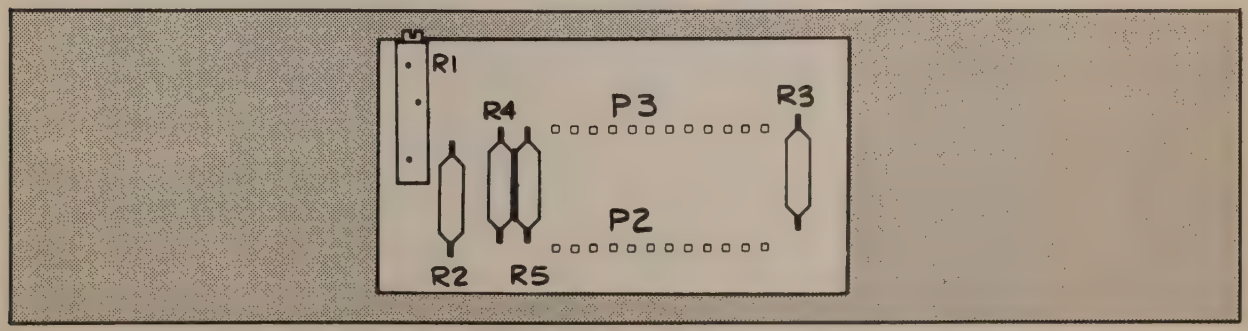


Figure 5-6. SINGLE TYPE PCB ASSEMBLY

MULTI-TYPE CONFIGURATION

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MULTI-TYPE CONFIGURATION **Figure 5-7**	2100A–06					
1	Decal, AC Power, Front Panel	381152	89536	381152	1		
2	Decal, Type Select, Front Panel	380857	89536	380857	1		
3A	Decal, Type 06C	381210	80536	381210	1		
3B	Decal, Type 06F	381202	89536	381202	1		
41	Front Panel, Finished	397653	80536	397653	1		
5	Single Input Assembly	405316	89536	405316	1		
6A	Static ROM °C	370023	89536	370023	1		
6B	Static ROM °F	370015	89536	370015	1		

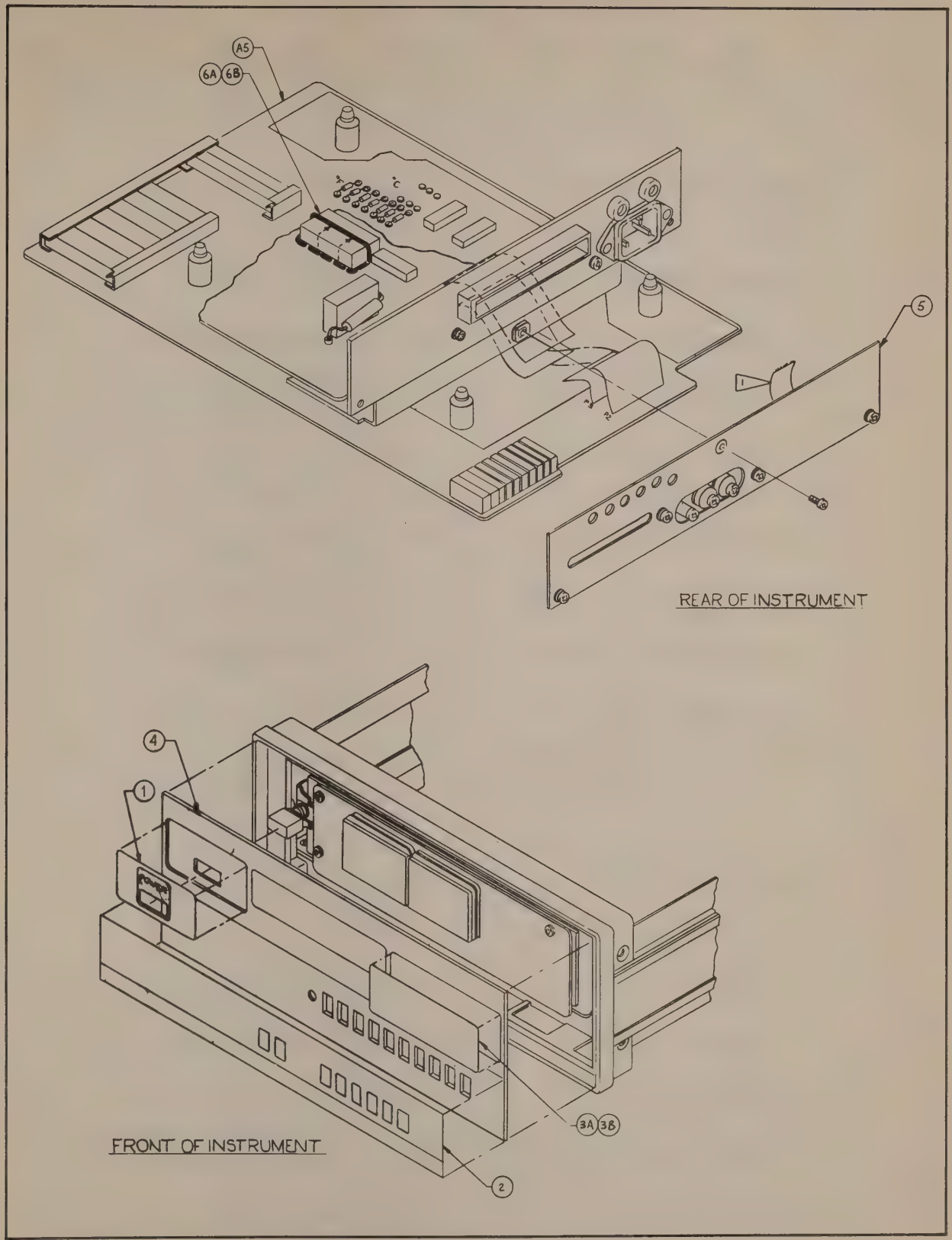


Figure 5-7. MULTI-TYPE CONFIGURATION

TYPE SELECT PCB ASSEMBLY °C

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	**TYPE SELECT PCB ASSEMBLY °C** **Figure 5-8**	371989	89536	371989			
CR1, CR2, CR3	Diode, Si, Hi-speed switching	289595	07910	1N4148	3		
R1	Res, met flm, 39.2k ±1%, 1/8W	236414	91637	MFF1–38922F	1		
R2	Res, fxd, sub-mini, ww, 60.75k ±0.1%	385625	54294	SP21D5–60751B	1		
R3	Res, var, cermet, 500 ±20%, ½W	267849	71450	190PC501B	1		
R4	Res, met flm, 57k ±1%, 1/8W	226217	91637	MFF1-8573F	1		
R5	Res, fxd, sub-mini, ww, 5.175k ±0.1%	385518	54294	SP21D5-51750B	1		
R6	Res, var, 50 ±20%, ½W	267815	71450	190PC500B	1		
R7	Res, met flm, 23.455k ±0.1%, 1/8w	386300	91637	MFF1-8234 551B	1		
R8	Res, met flm, 8.06k ±1%, 1/8W	294942	91637	MFF1-88061F	1		
R9	Res, fxd, sub-mini, ww, 11.97k ±0.1%	385559	54294	SP21D5-11971B	1		
R10, R14, R18, R22, R32, R45	Res, var, cermet, 100 ±20%, ½W	267823	71450	190PC 101B	6		
R11	REs, met flm, 29.931k ±0.1%, ½W	386318	91637	MFF1-829931B	1		
R12, R16	Res, met flm, 11.5k ±1%, 1/8W	267138	91637	MFF1-811501F	2		
R13	Res, sub-mini, ww, 17.55k ±0.1%	385567	54294	SP21D5–19551 B	1		
R15	Res, met flm, 29.784k ±0.1%, 1/8W	386326	91637	MFF1-829784B	1		
R17	Res, sub-mini, ww, 18.17k ±0.1%	385575	54294	SP21D5-18171B	1		

TYPE SELECT PCB ASSEMBLY °C (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R19	Res, met flm, 19.9k ±1%, 1/8W	386334	91637	MFF1-819928	1		
R20	Res, met flm, 7.68k ±1%, 1/8W	370999	91637	MFF1-876801B	1		
R21	Res, sub-mini, ww 11.35k ±0.1%	385542	54294	SP21D5= 11351B	1		
R23	Res, met flm, 204.5k ±0.1%, 1/8w	393793	91637	MFF1-820452B	1		
R24, R28	Res, met flm, 71.5k ±1%, 1/8w	291435	91637	MFF1-87151F	2		
R25, R29	Res, sub-mini, ww, 110.09k ±0.1%	385633	54294	SP21D5- 11009B	2		
R26, R30	Res, var, cermet, 1k ±20%, ½W	267856	71450	190PC102B	2		
R27	Res, met flm. 202.6k ±0.1%, 1/8W	386342	91637	MFF1–820262B	1		
R31	Res, sub-mini, ww, 9.975 ±0.1%	385526	54294	SP21D5- 99751B	1		
R33	Res, met flm, 44.563k ±0.1%, 1/8W	386367	91637	MFF1-844563B	1		
R34	Res, met flm, 55.947k ±0.1%, 1/8W	386383	91637	MFF1-855947B	1		
R35	Res, met flm, 55.09k ±0.1%, 1/8W	404038	91637	MFF1-855091B	1		
R36	Res, met flm, 37.01k ±0.1%, 1/8W	386425	91637	MFF1-837011B	1		
R37	Res, met flm, 368.9k ±0.1%, 1/8W	386441	91637	MFF1-836892B	1		
R38	Res, met flm, 366.7 ±0.1%, 1/8W	386466	91637	MFF1-836672B	1		
R39, R40, R41	Res, var, cermet, 5k ±10%, ½W	288282	71450	360S-502A	3		
R42, R43	Res, var, cermet, 25k ±10%, ½W	289678	71450	360S-253A	2		
S1 thru S 8	Switch Assembly	375246	89536	375246	1		

TYPE SELECT PCB ASSEMBLY °C (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U1	REs, network 10k ±5%, ¼W	355313	56889	Type 914C	1		
U2	IC, TTL, Hex Inverter	292979	01295	SN7404N	1		
U3	IC, TTL, Quad 2-input NOR Gate	288845	01295	SN7402N	1		
U4	IC, TTL, Triple, 3-input, pos NAND Gate	292995	01295	SN7410N	1		
U5	IC, TTL, Quad, 2-input NAND Gate	292953	01295	SN7400N	1		
	Button, putty grey	369546	71590	J52305 T31753	8		
	Cable, flex	385716	89536	385716	2		
	Guard, lower	374942	89536	374942	1		
	Spacer, switch	285353	71590	J64280	7		
	Spring contact	375360	89536	375360	1		

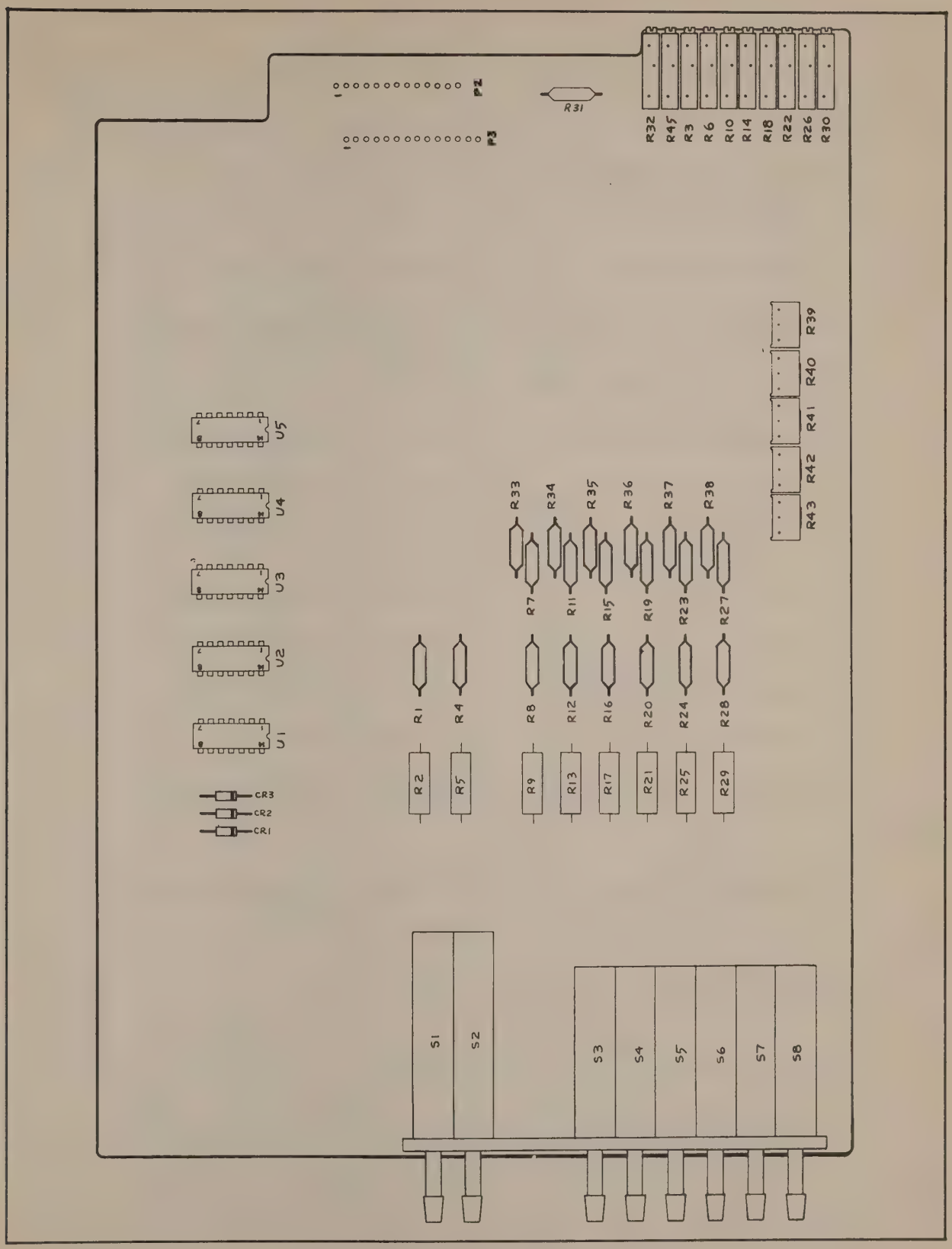


Figure 5-8. TYPE SELECT PCB ASSEMBLY °C

TYPE SELECT PCB ASSEMBLY °F

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	**TYPE SELECT PCB ASSEMBLY °F** **Figure 5-9**	371690	89536	371690			
CR4 thru CR10	Diode, Si, Hi-speed switching	289595	07910	1N4148	7		
R1	Res, met flm, 39.2k ±1%, 1/8W	236414	91637	MFF1-83920F	1		
R2	Res, fxd, sub-mini, ww, 60.75k ±0.1%	385625	54294	SP0215-L0751B	1		
R3	Res, var, cermet, 500 ±20%, ½W	267849	71450	190 PC 501B	1		
R4	Res, met flm, 57k ±1%, 1/8W	226217	91637	MFF1-8573F	1		
R5	Res, fxd, sub-mini, ww 5.175k ±0.1%	385518	54294	SP21D5-51750B	1		
R6	Res, var 50 ±20%, ½W	267815	71450	190 PC 500B	1		
R7	Res, met flm. 23.455k ±0.1% 1/8W	386300	91637	MFF1-8234551B	1		
R8	Res, met flm, 14.7k ±1%, 1/8W	226225	91637	MFF1-81472F	1		
R9	Res, fxd, sub-mini, ww, 23.7k ±0.1%	385609	54294	SP21D 52372B	1		
R10, R14, R18	Res, var, cermet, 200 ±20%, ½W	284711	71450	190 PC 201B	3		
R11	Res, met flm, 29.93k ±0.1%, 1/8W	386318	91637	MFF1–829931B	1		
R12, R16	Res, met, flm, 21k ±0.5%, 1/8W	229484	91637	MFF1-8213	2		
R13, R17	Res, fxd, sub-mini, ww, 32.38k ±0.1%	385617	54294	SP21D5-32381B	2		
R15	Res, met flm, 29.784k ±0.1%, 1/8W	386326	91637	MFF1-82978 40B	1		
R19	Res, met flm, 19.90k ±0.1%, 1/iW	386334	91637	MFF1-819901B	1		
R20	Res, met flm, 12.4k ±1%, 1/8W	261644	91637	MFF1-81242F	1		
R21	Res, fxd, sub-mini, 1941k ±0.1%	385583	54294	SP31D5-19411B	1		

TYPE SELECT PCB ASSEMBLY °F (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R22, R32, R45	Res, var, cermet, 100 ±20%, ½W	267823	71450	190 PC 101B	3		
R23	Res, met flm, 204.5k ±0.1%, 1/8W	393793	91637	MFF1-820452F	1		
R24, R28	Res, met flm, 71.5k ±1%, 1/8W	291435	91637	MFF1-87152F	2		
R25, R29	Res, sub-mini, ww, 110.09k ±01%,	385633	54294	SP2105-110091B	2		
R26, R30	Res, var, cermet, 1k ±20%, ½W	267856	71450	190 PC 102B	2		
R27	Res, met flm. 202.6k ±0.1%, 1/8W	386342	91637	MFF1820262B	1		
R31	Res, sub-mini, ww, 9.975 ±0.1%	385526	54294	SP21D5-99750B	1		
R33	Res, met flm. 121k ±0.1%, 1/8W	370817	91637	MFF1–81211B	1		
R34	Res, met flm. 149k ±0.1%, 1/8W	386375	91637	MFF1-81493B	1		
R35	Res, met flm. 137.04k ±0.1%, 1/8W	404046	91637	MFF1-8137041B	1		
R36	Res, met flm. 95.52K ±0.1%, 1/8W	386417	91637	MFF1-875521B	1		
R37	Res, met flm. 788.6k ±0.1%, 1/8W	386433	91637	MFF1-878862B	1		
R38	Res, met flm. 799.5k ±0.1%, 1/8W	386458	91637	MFF1-879952B	1		
R39, R40, R41	Res, var, cermet, 10k ±10%, ½W	285171	71450	360S103A	3		
R42, R43	Res, var, cermet, 50k ±10%, ½W	288290	71450	360S503A	2		
S1 thru S8	Switch Assembly	375246	89536	375246	1		
U1	Res, network, 10k ±5%, ¼W	355313	56289	914C 103J	1		
U2	IC, TTL, Hex inverter	292979	01295	SN7404N	1		
U3	IC, TTL, Quad, 2-input NOR gate	288845	01396	SN7402N	1		
U4	IC, TTL, Triple, 3-input, NAND Gates	292995	10295	SN7410N	1		

TYPE SELECT PCB ASSEMBLY °F (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U5	IC, TTL, Quad, 2-input NAND Gate	292953	01295	SN7400N	1		
	Button, putty grey	369546	71590	J52305 J31753	8		
	Cable, flex	385716	89536	385716	1		
	Contact, spring	375360	89536	375360	1		
	Guard, Lower, type select	374942	89536	374942	1		
	Insulator, –06 Guard	412072	89536	412072	1		
	Spacer, switch	285353	71590	J64280	7		

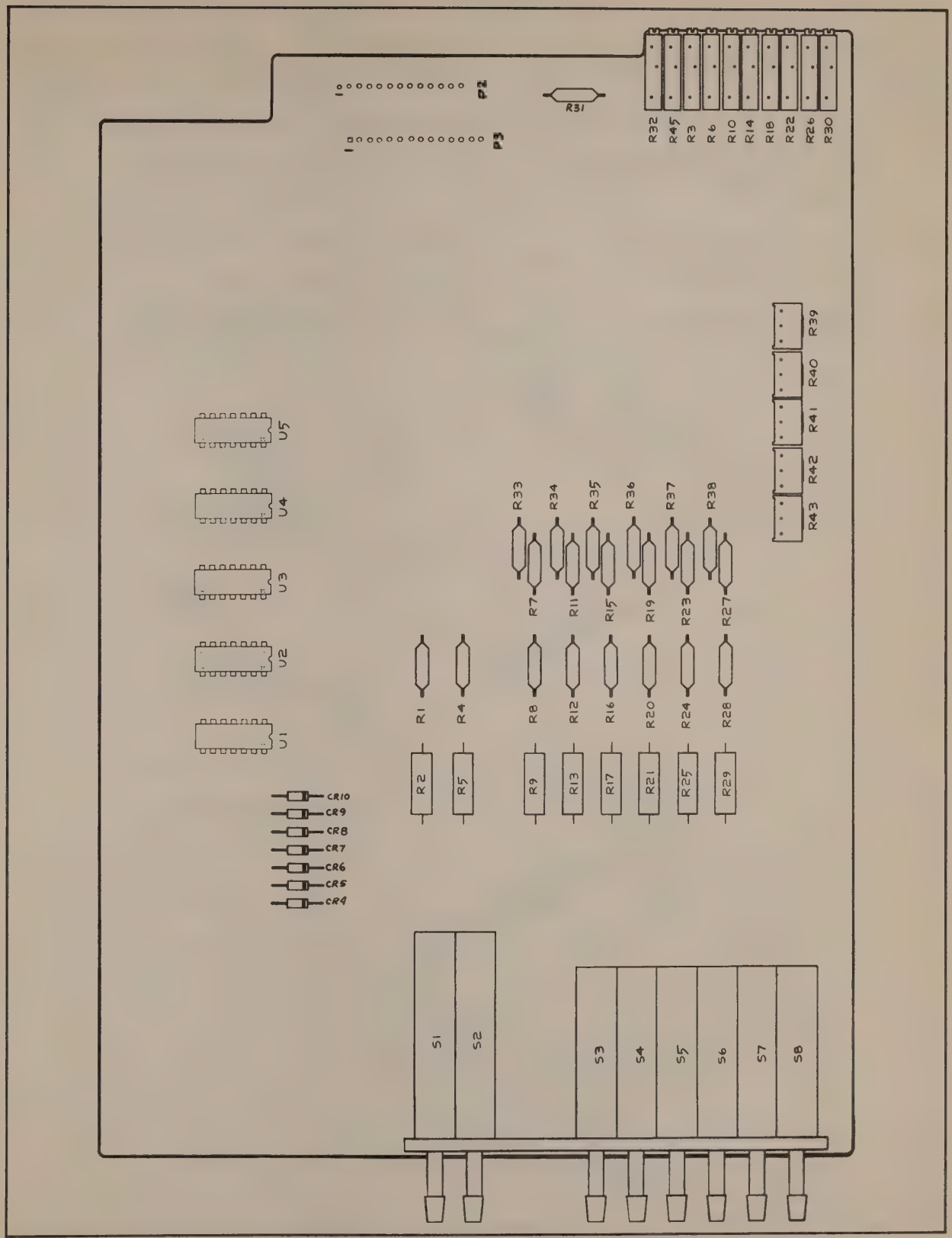


Figure 5-9. TYPE SELECT PCB ASSEMBLY °F

MULTI-POINT CONFIGURATION

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MULTI POINT CONFIGURATION Figure 5-10	2100A-10					
1	Decal, AC Power, Front Panel	381152	89536	381152	1		
2	Decal, Basic, Front Panel	380873	89536	380873	1		
3	Front Panel, Finished	397653	89536	397653	1		

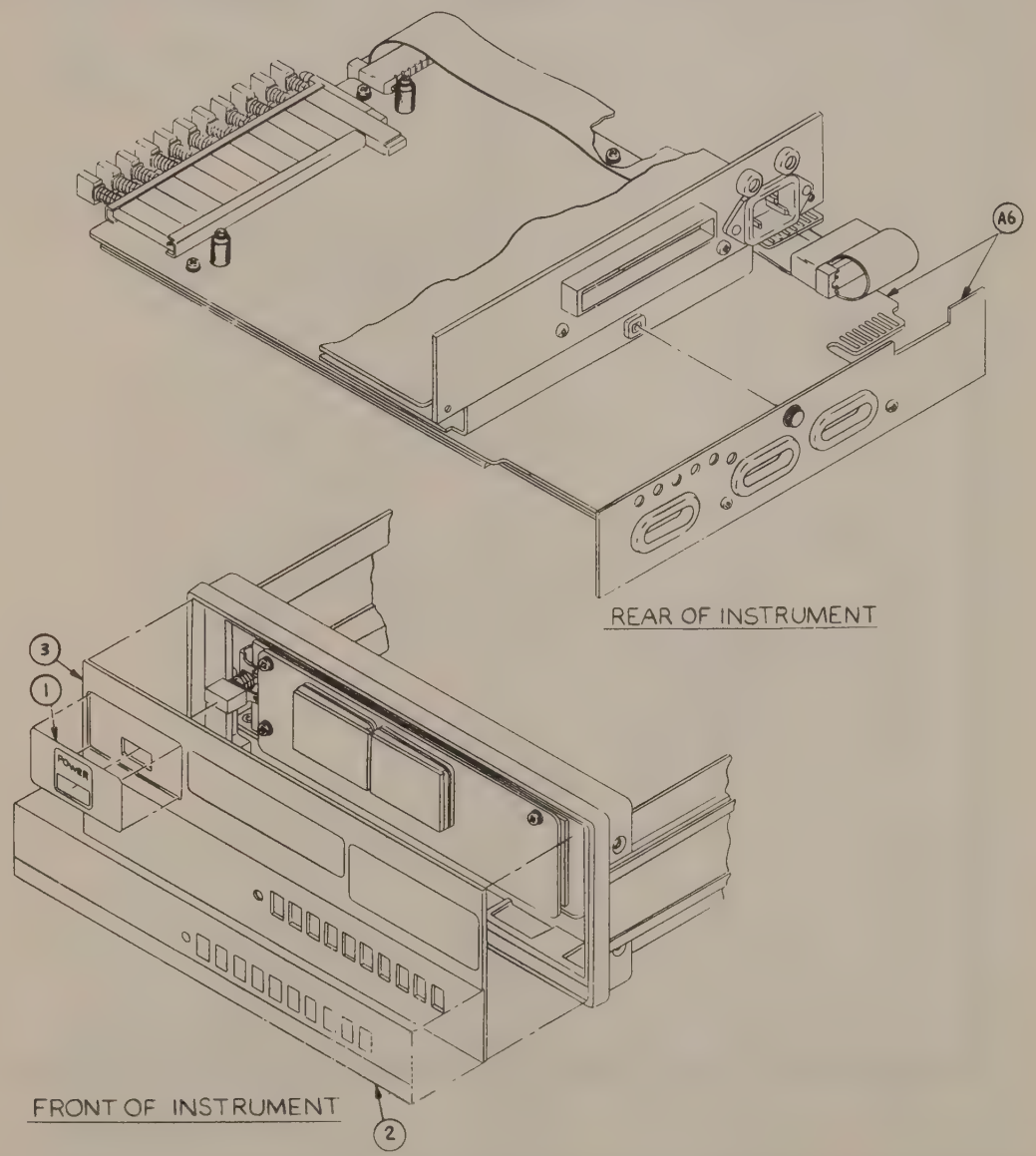


Figure 5-10. MULTI-POINT CONFIGURATION

POINT SELECT PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	**POINT SELECT PCB ASSEMBLY** **Figure 5-11**	373811	89536	373811			
CR1 thru CR4	Diode, Si	203323	07910	TD8253	4		
DS1	Light=emitting diode, red	309617	07263	FLV102	1		
R1	Res, comp, 330 ±5%, ¼W	147967	01121	CB3315	1		
R2, R3, CR5	Res, junction set	400127	89536	400127	3		
R4, R5, R6	Res, comp, 100 ±5%. ¼W	147926	01121	CB1015	3		
S1 thru S11	Switch Assy	375253	89536	375253	1		
U1	Diode, matrix, custom programmed	370676	91417	HM1-0104	1		
	Clamp, xstr	393967	89536	393967	1		
	Cover, xstr	394577	89536	394577	1		
	Flex circuit assy	395483	89536	395483	1		
	Gasket xstr	394585	89536	394585	1		
	Iso-thermal sink	380287	89536	380287	1		
	Lower guard	374082	89536	374082	1		
	Rear panel	374074	89536	374074	1		

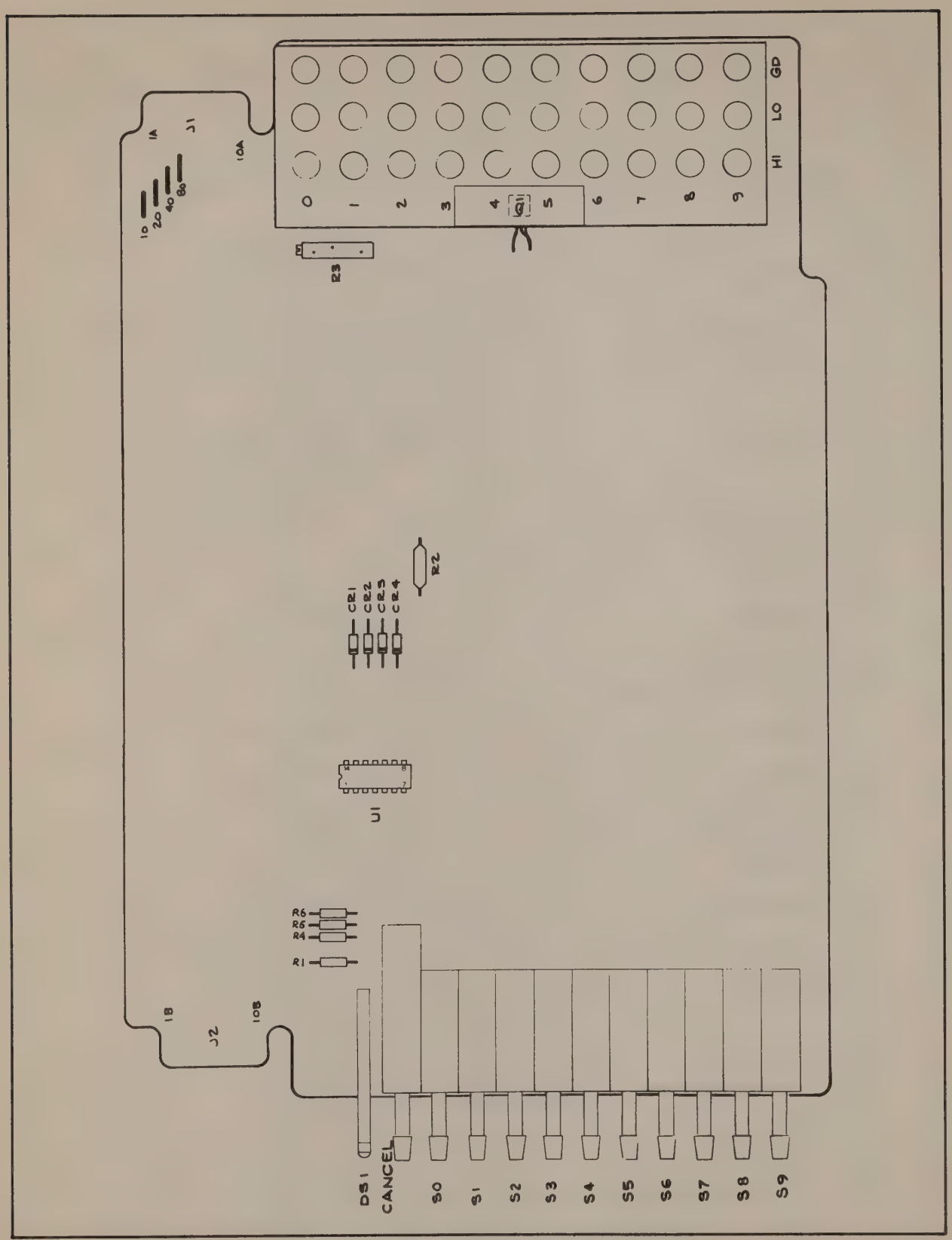


Figure 5-11. POINT SELECT PCB ASSEMBLY

BATTERY POWER SUPPLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	BATTERY POWER SUPPLY (Figure 5-12)	2100A–01					
BT1-BT9	Battery, Rechargeable (2100A–01)	370759	89536	370759	9		
1	Retainer, Battery	374066	89536	374066	2		
2	Screw, 4-40 x 1 3/8	404400	89536	404400	4		
3	Battery Charge Assembly	374645	89536	374645	1		
4	Battery Cable Harness	372243	89536	372243	1		
5	Battery Support	373308	89536	373308			
A7	Battery Charge PCB Assembly	374645	89536	374645	1		

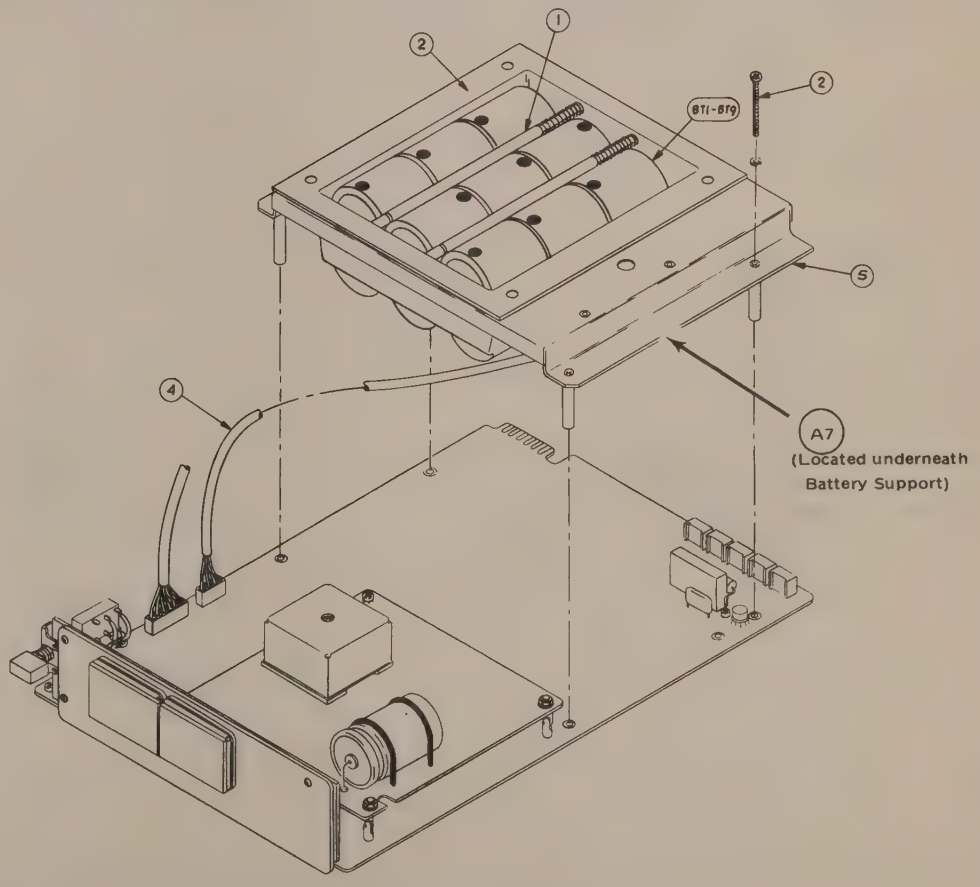


Figure 5-12. BATTERY POWER SUPPLY

BATTERY CHARGE PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	BATTERY CHARGE PCB ASSEMBLY Figure 5-13	374645	89536	374645			
CR1 thru CR4	Diode, Si, 100 piv	116111	05277	1N481	4		
Q1	Xstr, Si, PNP	195974	04713	2N3906	1		
Q2	Xstr, power PNP	325753	03508	D45C5	1		
R1	Res, comp 1.6 ±5% ½W	218727	01121	EB16G5	1		
R2	Res, comp 470 ±5%, ½W	108787	01121	EB4715	1		

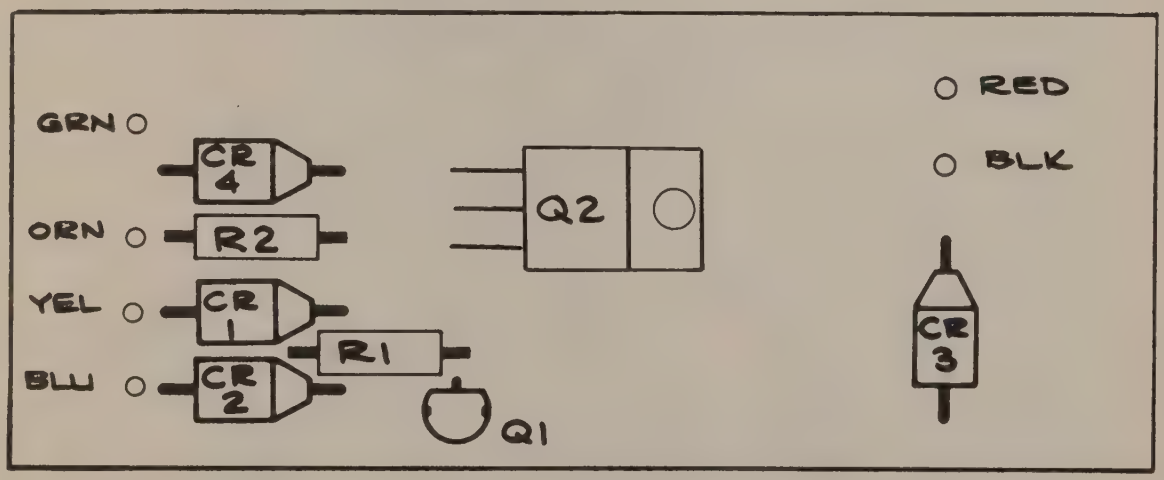


Figure 5-13. BATTERY CHARGE PCB ASSEMBLY

DIGITAL OUTPUT UNIT PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A8	DIGITAL OUTPUT UNIT PCB ASSY Figure 5-14	371526	89536	371526	REF		
C1	Cap, cer, 500 pF ±10%, 1kV	105692	32897	2D0H60N50 1K	1		
C2	Cap, cer, 180 pF ±10%, 1kV	105890	71590	BB60181K S3N	1		
C3,C4	Cap, Ta, 10 uF ±20%, 20V	330662	56289	196D106X 0020JA1	2		
C5	Cap, cer, 0.01 uF ±20%, 100V	149153	56289	C023B101 F103M	1		
C6	Cap, mica, 33 pF ±5%, 500V	160317	71236	DM15E330J	1		
CR1 thru CR3	Diode, Si, Rect - 1 amp	343491	04713	1N4002	3		
Q1 thru Q4	Xstr, Si, NPN	218396	04713	2N3904	4		
R1,R2, R18	Res, comp, 51k ±5%, ¼W	193334	01121	CB5135	3		
R3,R4, R5, R13	Res, comp, 100k ±5%, ¼W	148189	01121	CB1045	4		
R6,R8, R10	Res, comp, 2k ±5%, ¼W	202879	01121	CB2025	3		
R7,R9, R11	Res, comp 16k ±5% ¼W	221606	01121	CB1635	3		
R12	Res, comp 15k ±5%, ¼W	148114	01121	CB1535	1		
R14, R17	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	2		
R15, R16	Res, comp, 33k ±5%, ¼W	148155	01121	CB3335	2		
R19, R20, R21	Res, comp, 200 k ±5%, ¼W	248781	01121	CB2045	3		

DIGITAL OUTPUT UNIT PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
T1	Xfmr, pwr, 8 kHz	377812	89536	377812	1		
U1	IC, C-MOS, Quad 2-input NAND Gate	355198	04713	MC14011CP	1		
U2,U19, U22	IC, C-MOS, NOR Gates	355172	04713	MC14000CL	3		
U3,U4, U6,U7, U11,U13	IC, C–MOS, Quad Bilateral Switch	363838	12040	MM5616AN	6		
U5	IC, C-MOS, Dual J-K Master Slave Flip-Flop	355230	04713	MC14027CL	1		
U8,U18	IC, C-MOS, Dual "D" Flip-Flop	340117	04713	MC14013CL	2		
U9,U17 U20, U27 thru U32	IC, C-MOS, Hex Buffer/Conv	355214	04713	MC14009CP	9		
U10	Res, Network, 6k	355131	56289	Type 914C	1		
U12, U21 U23 thru U26	IC, C-MOS, Dual 4-Bit Static Shift Register	340125	04713	MC14015CP	6		
U14, U15, U16	IC, Opto-Isolator	380014	01295	TIL116	3		
	Cable, flex	376293	15912	.100F401S2A10	2		
	Guard, DOU	378042	89536	378042	1		
	Mini-sert	376418	22526	75060-005	10		

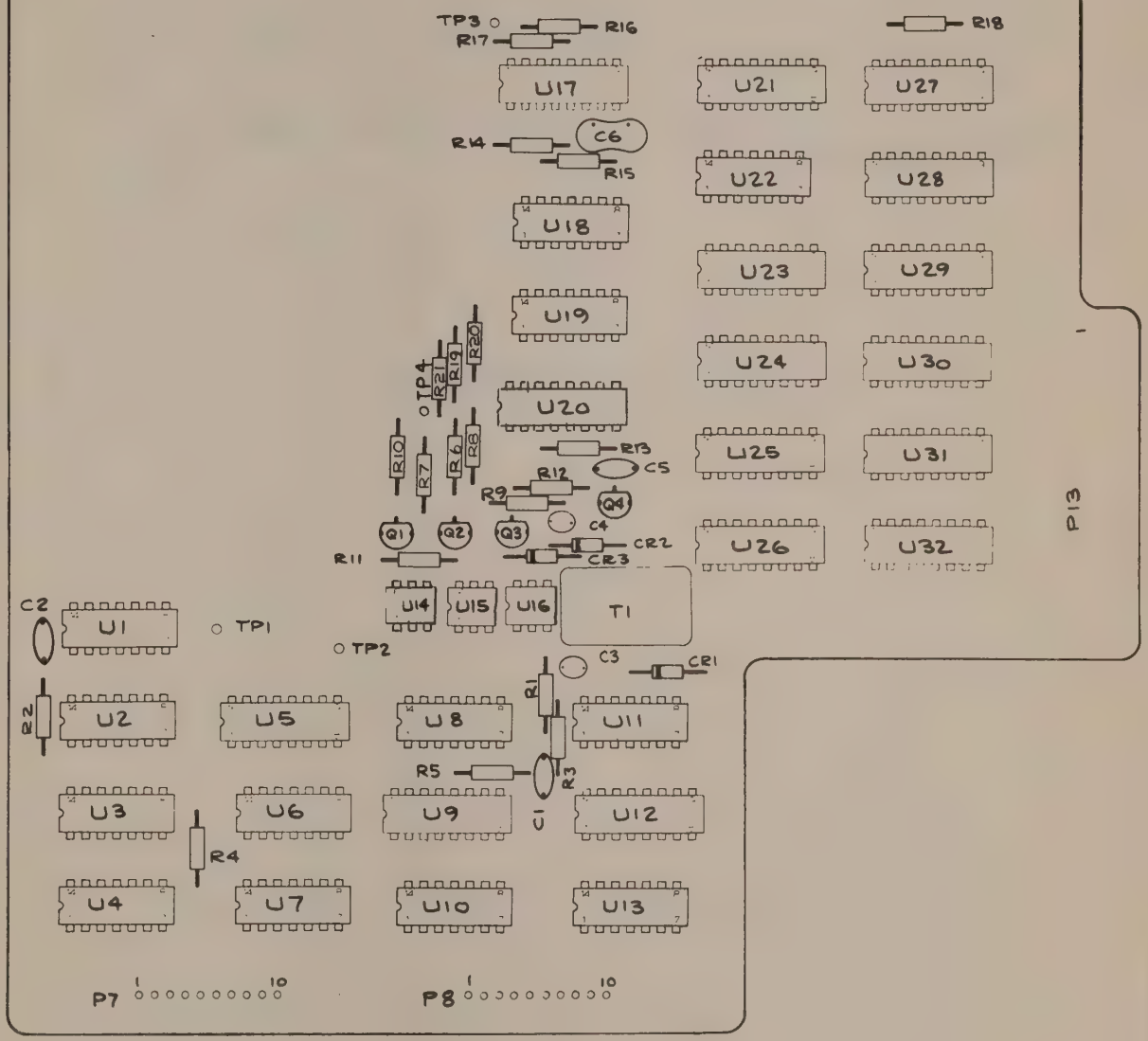


Figure 5-14. DIGITAL OUTPUT UNIT PCB ASSEMBLY

ANALOG OUTPUT UNIT

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ANALOG OUTPUT UNIT (Option -04)	2100A-04					
	ANALOG OUTPUT UNIT PCB ASSEMBLY	415380	89536	415380	1		
	ANALOG OUTPUT UNIT REAR PANEL ASSEMBLY	409631	89536	409631	1		

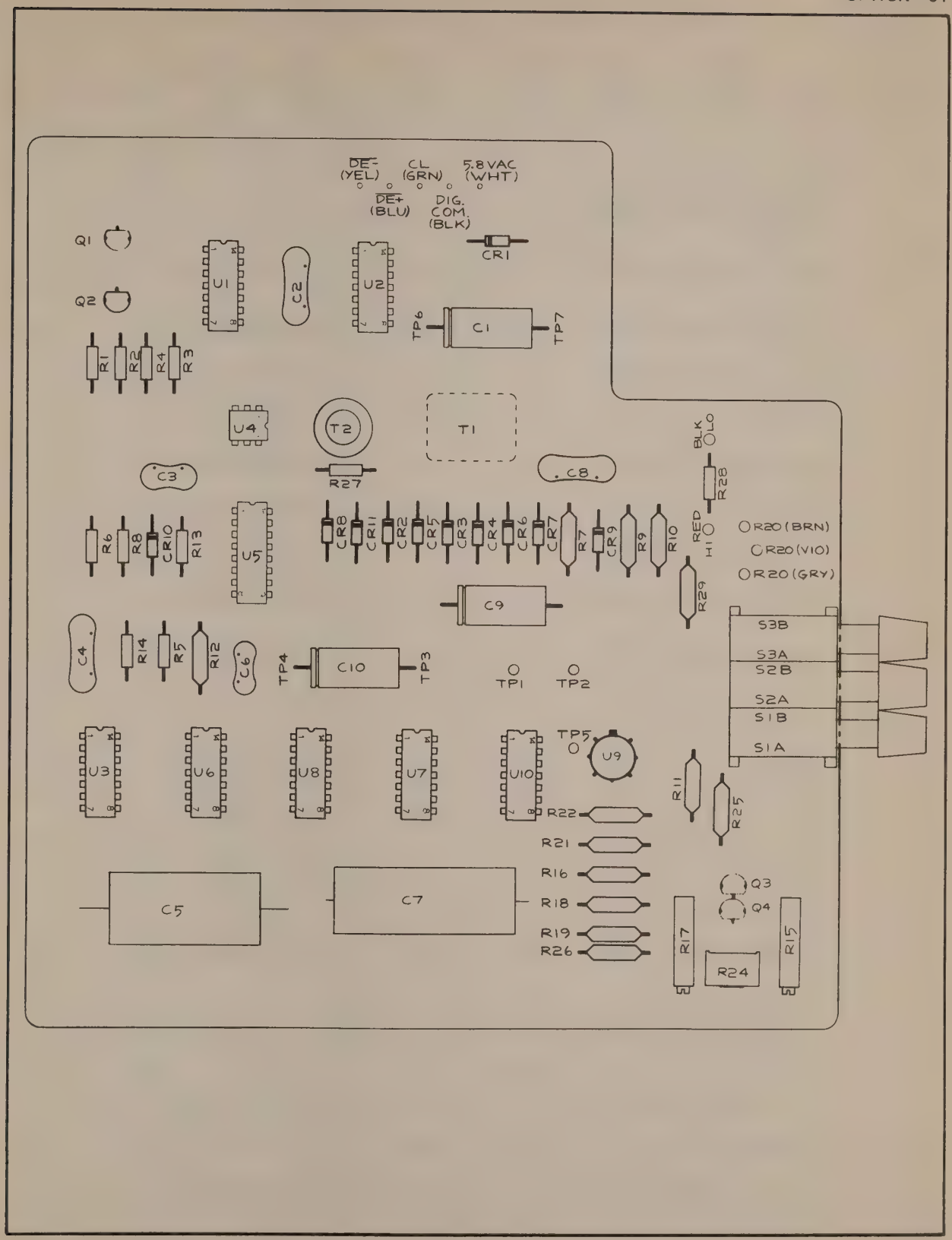


Figure 5-15. ANALOG OUTPUT UNIT PCB ASSEMBLY.

ANALOG OUTPUT UNIT PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ANALOG OUTPUT UNIT PCB, ASSEMBLY (2100A-4026) Figure 5-15				REF		
C1,C9 C10	Cap, elect, 150 uF –10/+50%, 16v	186296	73445	ET151X016A5	3		
C2	Cap, mica, 820 pF ±5%, 500v	148395	71236	DM19F821J	1		
C3	Cap, mica, 150 pF ±5%, 500v	148478	71236	DM15F151J	1		
C4	Cap, plstc, .010 uF ±10%' 50v	309906	06001	75F1R5A103	1		
C5	Cap, mylar, 2 uF ±10%, 200v	106443	74411	X663F20552W	1		
C6	Cap, mica, 360 pF ±1%, 500v	170407	71236	CM15F361F	1		
C7	Cap, mylar, 1 uF ±20%' 120v	193748	84411	JF-11	1		
C8	Cap, mylar, .047 uF ±10%, 50v	271858	06001	75F1R5A473	1		
CR1, thru CR8, Cr10 CR11	Diode, Si, hi-speed switcing	203323	09214	DHD1105	10		
CR9	Diode, zener, 6.2V	330829	07910	1N4571	1		
Q1,Q2	Xstr, J-FET, N-channel	376475	12040	SF50072	2		
Q3,Q4	Xstr, Si, NPN	218396	04713	2N3904	2		
R1,R2	Res, comp, 1k ±5%, ¼w	343426	01121	CB1025	2		
R3,R6, R28	Res, comp, 10k ±5%, ¼w	348839	01121	CB1035	3		
R4	Res, comp, 270 ±5%, ¼w	348789	01121	CB2715	1		
R5	Res, comp 51k ±5%, ¼w	376434	01121	CB5135	1		
R7	Res, mf, 2.05k ±1%, 1/8w	347013	91637	MFF1-82051F	1		
R8	Res, comp, 5.1k ±5%, ¼w	368712	01121	CB5125	1		
R9	Res, mf, 10k ±1%, 1/8w	168260	91637	MFF1-81002F	1		

ANALOG OUTPUT UNIT PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R10	Res, mf, 3.74k ±1%' 1/8w	272096	91736	MFF1-83741F	1		
R11, R19	Res, mf, 1.5k ±1%, 1/8w	313098	91637	MFF1-81511F	2		
R12	Res, mf, 1k ±1%, 1/8w	168229	91637	MFF1-8102F	1		
R13	Res, comp, 220k ±5%, ¼w	384953	01121	CB2245	1		
R14	Res, comp, 470k ±5%, ¼w	342634	01121	CB4745	1		
R15	Pot, cermet, 50 ±20%, ½w	267849	71450	190PC501B	1		
R16	Res, mf, 68.1 ±1%, 1/8w	305995	91637	MFF1-86841F	1		
R17	Pot, cermet, 50 ±20%, ½w	267815	71450	190DC500B	1		
R18	Res, mf, 750 ±1%, 1/8w	312801	91637	MFF1-89500F	1		
R21, R22	REs, mf, 5.11k ±1%, 1/8w	294868	91637	MFF1-85111F	1		
R24	Pot, cermet, 50 ±10%, ½w	285122	71450	360S-500A	1		
R25	Res, mf, 22.1 ±1%, 1/8w	261081	91637	MFF1-822R1F	1		
R26	Res, mf, 402 ±1%, 1/8w	343400	01121	MFF1-844020F	1		
R27	Res, comp, 2.2k ±5%, ¼w	226209	91637	CB2225	1		
R29	Res, mf 2.49k ±1%' 1/8w	226209	91637	MFF1-82491F	1		
S1 Thru S3	Switch assembly, push-button	414466	89536	414466	1		
T1	Xfmr, power	377812	89536	377812	1		
T2	Xsmr	416298	89536	416198	1		
U1	IC, TTL, dual D-type flip-flop	310227	01295	SN7474	1		
U2	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00	1		
U3	IC, MOS, dual D-typ filp-flop	340117	01295	MC14013L	1		
U4	IC, opto-isolator	380014	01295	T1L 116	1		

ANALOG OUTPUT UNIT PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U5	IC, C-MOS, hex buffer/invertor	381848	86684	CD4040	1		
U6	IC, C-MOS, quad bilateral switch	408062	86684	CD4066A+	1		
U7, U10	IC, C-MOS, quad bilateral switch	363838	86684	CD4016AE	2		
U8	IC, C-MOS, quad opnl ampl.	402669	12040	LM 324	1		
U9	IC, opnl ampl	357830	12040	LH0042CH	1		
	Guard, transforemr	303412	89536	303412	1		
	Button, switch	369546	71590	J52305-T31753	3		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ANALOG OUTPUT UNIT REAR PANEL ASSEMBLY (2100A-4405) (Figure 5-16)				REF		
J1	Jack, banana, red	162065	74970	108902	1		
J2	Jack, banana, black	162073	74970	108903	1		
R20	Pot, 15-turn, 1k ±10%, ¾w	417691	80294	3006P-1-100	1		
1	Panel, rear, analog output unit	405928	89536	405928	1		

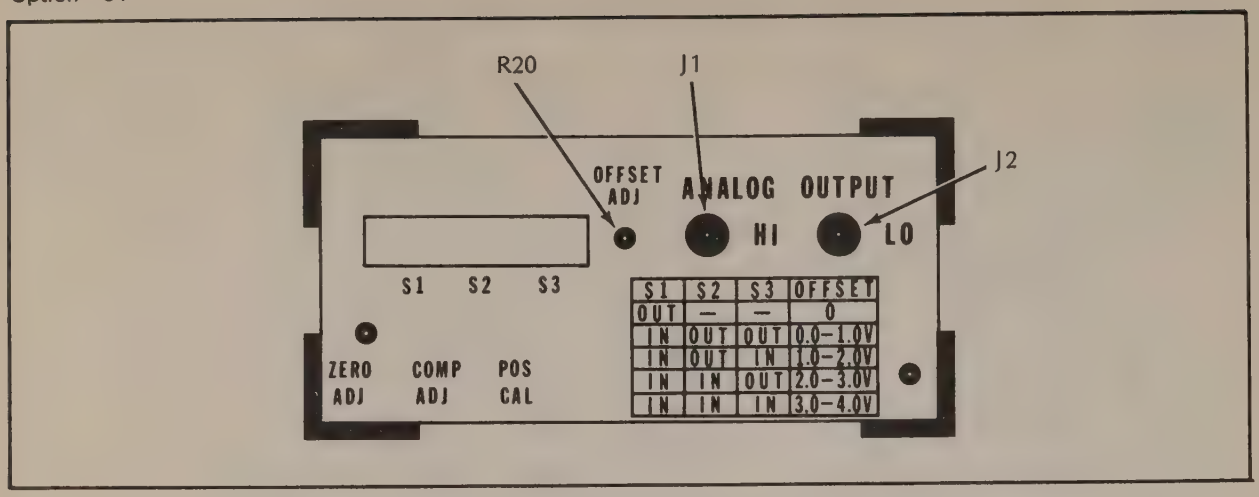


Figure 5-16. ANALOG OUTPUT UNIT REAR PANEL ASSEMBLY.

Section 6
Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the options and accessories available for your instrument. Each option and accessory is described under an identifying major heading. The descriptions contain operating and maintenance instructions, and field installation procedures where applicable. A list of replaceable parts and schematics for all options are given in Section 5 and 8, respectively.

6-3. CARRYING CASE (C81)

6-4. The Model C81 Carrying Case, Figure 6-1, is a fiber-glass container for convenient transport or shipment of the 2100A. A foam liner provides the instrument protection from extreme shock. A separate storage compartment provides space for thermocouples, instruction manual, etc.

Figure 6-1. C81, CARRYING CASE

6-5. FRONT PANEL COVER (M03-203-700)

6-6. The front panel cover is a molded plastic snap-on accessory which fits over the front panel of the 2100A. The cover provides protection for the front panel controls and display lens, and is useful when storing or transporting the 2100A.

6-7. INSTRUMENT MOUNTING KITS

6-8. Introduction

6-9. Three mounting kits are available for the 2100A. Two kits provide either side-by-side or offset mounting in a standard 19-inch equipment rack; the third kit allows the 2100A to be mounted in any rigid panel (cabinet, console, etc.). Table 6-1 lists the part numbers for each mounting kit.

Table 6-1. MOUNTING KITS

MOUNTING STYLE	MODEL NUMBER
Side-by-Side Rack Mounting	M00-200-618
Offset Rack Mounting	M00-200-619
Panel Mounting	M00-200-620

6-10. Installation Procedures

6-11. Installation instructions for each of the mounting kits is given in the following paragraphs. Use the procedure which corresponds to the model number of the kit being installed.

6-12. SIDE-BY-SIDE RACK MOUNTING KIT (M00-200-618)

a. Remove the top and bottom dust covers from one instrument.

b. Remove the feet from the bottom covers.

c. Remove handle disk decals and the handles.

d. Remove the side trim decals to expose the mounting holes.

e. Remove the printed circuit boards from the uncovered unit. (See the Access information in Section 4).

f. Remove the guard enclosure (not shown).

g. Insert three (3) 8-32 fasteners through the side of the unit, from which the guard enclosure was removed, into the captive nuts on the side of the other unit (see Figure 6-2).

h. Replace the guard enclosure and printed circuit boards.

i. Secure the rack ears to the sides, at the front panel end of the assembled units, as shown in Figure 6-2.

j. Replace the top and bottom dust covers.

d. Attach the rack ear extension bracket to the rack ear extension using three elastic stop nuts. (See Figure 6-3).

6-13. OFFSET RACK MOUNTING KIT

a. Remove the feet from the bottom cover.

b. Remove the handle disk decals and handle.

c. Remove the side trim decals to expose the mounting holes.

e. Attach the assembled extension to the left or right side (dependent on the offset desired, right or left) of the unit.

f. Attach the rack ear to the other side of the unit.

g. Secure the brace support between the rack extension and side of the unit as shown in Figure 6-3.

6-14. PANEL MOUNTING.

6-15. Prepare the cutout in the panel as indicated in Figure 6-4. Insure that the dimensions given for the cutout are followed precisely. Install the 2100A in the panel as follows:

a. Remove the handle disc decals and the handle from the 2100A.

b. Remove the chassis side decals.

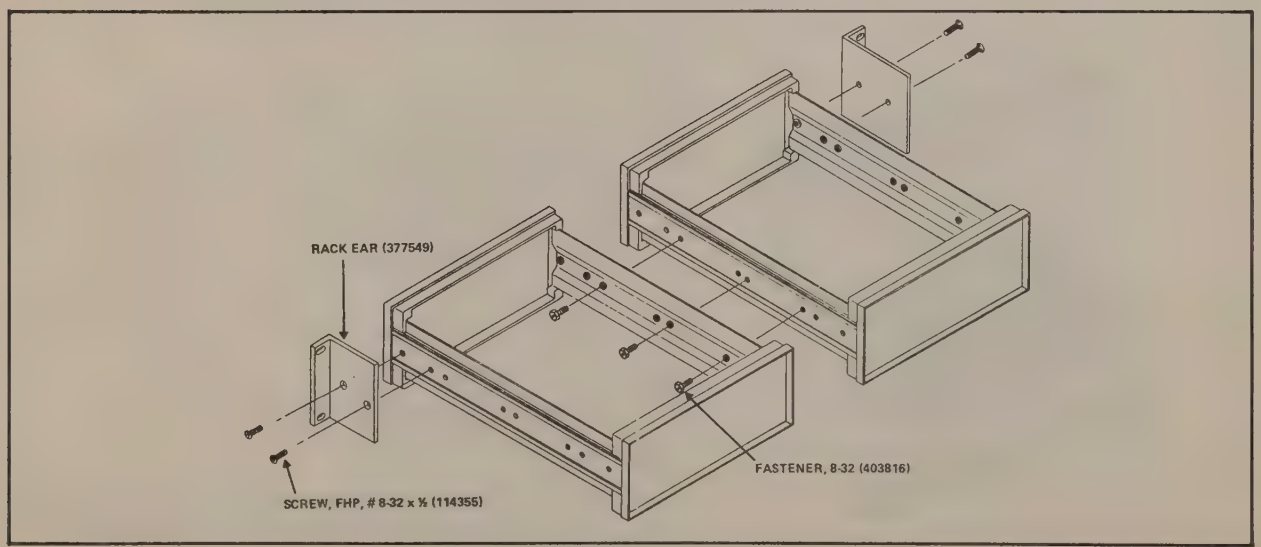


Figure 6-2. SIDE-BY-SIDE RACK MOUNTING

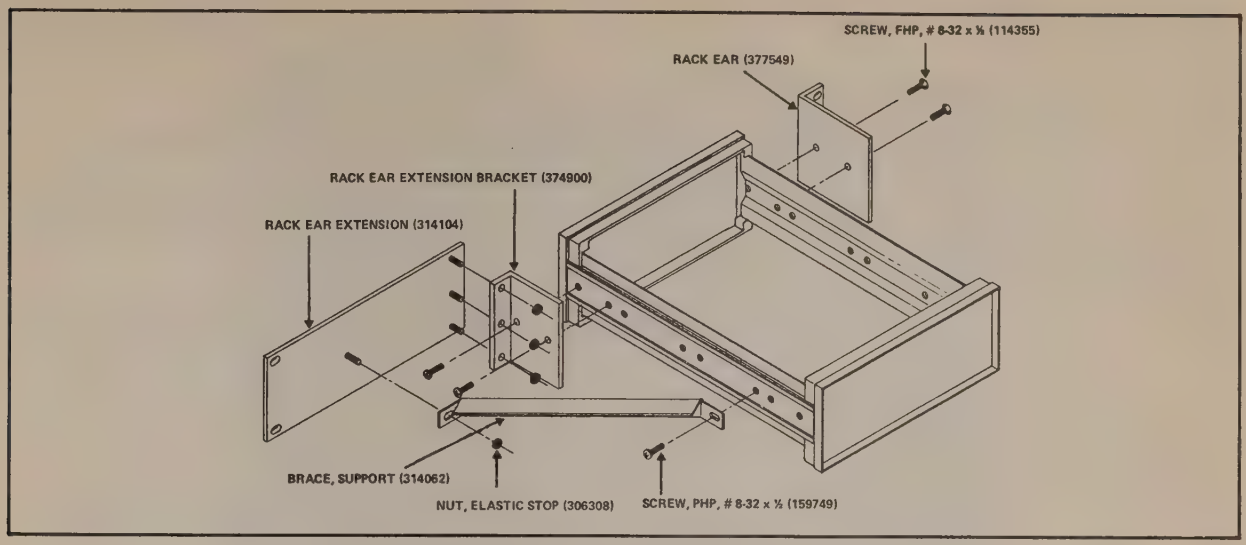

SCREW, FHP, # 8-32 x ¼ (114365)
RACK EAR (377549)
RACK EAR EXTENSION BRACKET (374900)
RACK EAR EXTENSION (314104)
BRACE, SUPPORT (314062)
NUT, ELASTIC STOP (306308)
SCREW, PHP, # 8-32 x ¼ (159749)

Figure 6-3. OFFSET RACK MOUNTING

c. Position the panel mount rack ear against the side of the chassis as shown in Figure 6-4 and secure it in place with two screws. Repeat on the opposite side.

d. Insert the 2100A into the panel cutout from the rear and fasten it to the panel with the screws provided.

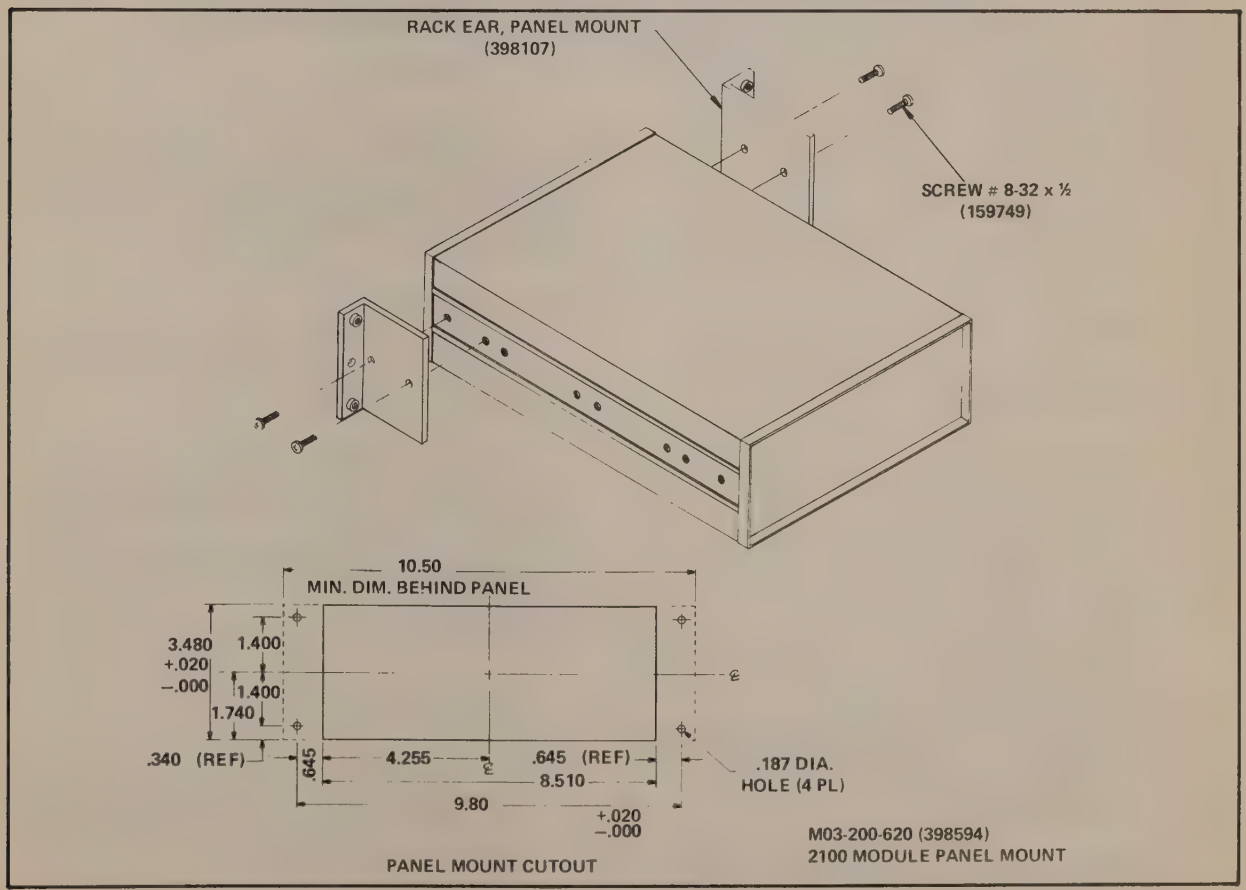


Figure 6-4. PANEL MOUNTING

6-16. THERMOCOUPLE PROBES

6-17. Three thermocouple probes (J type, K type, and T type) are available from Fluke as accessories for the 2100A. The thermocouple junction of each probe is connected to the tip of a six inch long one-eighth inch diameter Inconel sheath. Three feet of insulated conductor provide thermocouple connection to the 2100A' The conductor insulation can withstand continuously applied temperatures up to +480° C , (+900°F) or temperatures for a single reading up to +760°C (+1400°C)

6-18. The thermocouple probes (J type, K type, or T type) can be ordered by model numbers P20J, P20K, or P20T, respectively. The type of thermocouple must match the single type configuration of the 2100A–03 or 2100A–10 it is to be used with.

6-19. THERMOCOUPLE TYPE CONVERSION KIT (2100A - —— K

6-20. Introduction

6-21. The 2100A–03 or 2100A–10 configured for a particular type thermocouple can be changed to accommodate a new type thermocouple by installing a thermocouple type conversion kit. Each specific conversion kit is identified by filling in the two blanks in the (2100A - _ _ K) model identification. That is, a kit to accommodate a T type thermocouple in an instrument that displays the termperature in degrees Fahrenheit would be 2100A–TFK. The letter placed in the first blank identifies the thermocouple type (J, K, E, T, R, or S); the letter in the second blank indicates the temperature unit, degrees Celsius (C) or degrees Fahrenheit (F).

6-22. Installation

6-23. Use the following procedure to install the 2100 A- _ _ K in the 2100A instrument.

a. Remove the line power cord from the instrument.

b. Remove the four retainer screws from the rear panel; two on the extreme left and two on the extreme right of the panel.

c. Pull the rear panel straight back from the outer case about five inches.

d. Locate and remove the old thermocouple type PCB (see Figure 6-5). Use both hands, one at each end of the type pcb, to pull the pcb straight up from the Basic PCB Assembly.

e. Position the new type pcb as indicated in Figure 6-5, i.e., upside down as viewed from the rear of the instrument.

f. Align P2 pins 2 thru 13 and P3 pins 1 thru 12, on the type pcb with J-2 pins 2 thru 13 and J3 pins 1 thru 12 of the basic pcb.

g. Press the type pcb down until the pins seat.

h. Remove the old thermocouple type identification decal from the front panel; insert a knife point under one corner and peel it back.

i. Remove the paper back from the new identification decal and press it into place on the front panel.

j. Slide the instrument back into the outer case and secure it in place .

k. Connect the line power cord to the instrument, press the power switch, and allow it to warm up for one-half hour.

l. Recalibrate the instrument following the procedure of section four as they pertain to the new type thermocouple.

6-24. FAHRENHEIT TO CELSIUS CONVERSION KIT (F2CK)

6-25. Introduction

6-26. The 2100A–03 and 2100A–10 are configured to display temperature in either degrees Fahrenheit or degrees Celsius. Either instrument can be converted from Fahrenheit to Celsius display by installing the 2100A - _ _ K and the 2100A - F2CK.

6-27. Installation

6-28. The following procedure provides step-by-step instructions for installing the 2100A–F2CK.

a. Remove the 2100A chassis from the outer case as described in steps a, b, and c of paragraph 6-21.

b. Locate and remove the old Read Only Memory (ROM) U22.

NOTE

Use an IC extraction tool to remove the ROM

c. Align the new ROM as shown in Figure 6-5 and press it into place in the IC socket; pin number one should be at the upper left of the ROM as viewed from the rear of the instrument.

d. Reassemble the instrument.

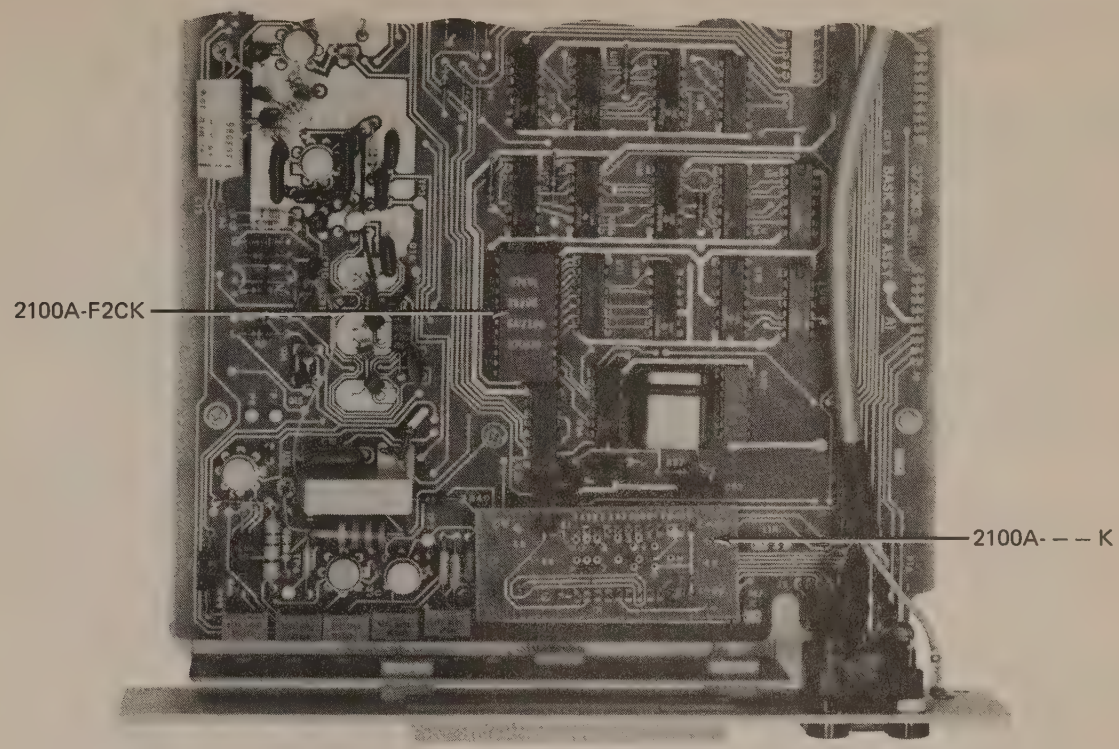


Figure 6-5. 2100A-–– K AND F2CK LOCATION

e. Calibrate the 2100A in accordance with the procedure in Section 4 as it pertains to the new configuration of the instrument.

6-29, MULTI-POINT SELECTOR SWITCH (2100A-10K)

6-30. Introduction

6-31. The 2100A–10K provides for field conversion from the 2100A–03 single point configuration to the 2100A–10 multipoint configureation. Up to ten thermocouples (all of the same type) can be connected to the 2100A equipped with the multi-point selector switch. Each thermocouple can be selected for display by pressing one of the ten selector switches.

6-32. Installation

6-33. The following instructions provide a step-by-step procedure for the installation of the 2100A–10K.

a. Remove the 2100A from the outer case. Four screws on the rear panel (two each side) secure it in place.

b. Remove the lower half of the rear panel.

NOTE

Use care when removing the flex connector from J5 on the Main PCB Assy.

c. Plug one end of the connector cable into J2 on the Multi-Point Assy.

d. Plug the other end of the cable into P1 on the rear of the Main PCB Assy.

e. Place the ends of the four plastic standoffs, mounted on the Multi-Point PCB Assy into the slots in the guard cover on the bottom of the Main PCB Assy.

f. Slide the Multi-Point Assy forward until the two halves of the rear panel are together and secure them with the center mounted thumb screw.

g. Remove the plastic shield covering the lower half of the outer case front panel.

h. Slide the assembled 2100A–10 into the outer case and secure it with two screws.

6-34. OPTION –01 BATTERY PACK

6-35. Introduction

6-36. The 2100A–03, –06, and –10 instruments can be fitted with a battery pack to provide up to seven hours of continuous operation free from external power sources. The battery pack is mounted inside the 2100A case, causing no change in outside dimensions. There is, however, an increase of about two pounds in total instrument weight. Recharging the battery is accomplished by connecting the instrument, via the line power cord, to the appropriate ac power source and turning the instrument on. Recharging will take a maximum of 16 hours.

6-37. Option –01 Operation

CAUTION!

Damage may result if alkaline, zinc-carbon, or mercury batteries are charged in the 2100A.

6-38. With a fully charged Battery Pack, the 2100A can be disconnected from line power and operated for approximately 7 hours, as a portable instrument. When the least significant digit shows excessive instability plug the 2100A back into line power; the instability of the digit should immediately stop. This is an indication that the battery is low. If battery operation of the 2100A is continued after instability of the last digit begins, the instrument will stop operating in about 15 minutes.

6-39. Recharging a fully discharged Battery Pack takes about 14 hours. This is accomplished by connecting the 2100A to line power and turning the unit on. The time required to charge the batteries is not significantly affected by operating the 2100A while charging.

NOTE

Battery manufacturers recommend that Ni-cad batteries be recharged at least every 90 days. Storage temperatures below +25°C are recommended.

6-40. There are some phenomena that should be considered when charging nickel-cadmium batteries. For instance, charging Ni-Cad batteries with cell case temperatures above 25°C will cause the cell's charge capacity to decrease. The decrease in capacity is linear from 100% of rated capacity at 25°C to only 60% of rated capacity at 50°C, and as low as 45% at 60°C. Cell case temperatures typically run from 5°C to 10°C above ambient temperature during charging due to heat dissipated by the charging circuit.

6-41. Charging capacity may also be affected by a cell's charge-discharge routine, due to a memory-type phenomena. For instance, if a Ni-Cad battery pack is used in a daily routine where it is allowed to discharge by only 30% before being fully recharged again, it will eventually become a battery pack capable of delivering only 30% of its rated capacity. To return such a battery pack to its rated capacity, connect an external load to completely discharge the battery at a rate equal to its capacity divided by 20. For example, a pack of nine series-connected 1.2 - volt cells having individual capacity ratings of 2.3 ampere hours should be discharged at 2.3 amp hrs/20 = .115 amp. This requires a load resistor of 10.8V/.115 amp = 100 ohms (approximate) with a wattage rating of at least (10.8V) (.115 amp) = 1.25W. (A 2-watt carbon composition resistor would be suitable.)

6-42. Allow the battery pack to discharge for 30 hours, then charge the battery pack at twice the discharge rate for 20 hours. (In the example, the charging rate would be 0.23 amperes at10.8 volts.) When charging is complete, discharge the pack at the capacity - divided-by-20 rate for 30 hours, then recharge at twice the discharge rate for 20 hours. The battery pack should now be restored to its rated capacity.

6-43. Option –01 Theory of Operation

6-44. The battery charging circuitry, shown in Figure 6-6, will supply charging current to a low battery when the 2100A is connected to line power. The output from the secondary of T1 is connected, via rectifier diodes CR1 and CR2, to a constant current source comprised of Q1, Q2, R1, R2, and CR3. This current source operates as long as the 2100A has line power applied and the power switch is on. When the ac line power is disconnected from the 2100A, operating power comes from the battery via CR4.

6-45. OPTION –01 Installation

6-46. The following procedure provides step-by-step instruction for installing the battery pack in the 2100A.

a. Remove the line power cord from the instrument.

b. Remove the four retainer screws from the rear panel, two on each side.

c. Pull the rear panel straight back from the outer case to expose the interior of the instrument.

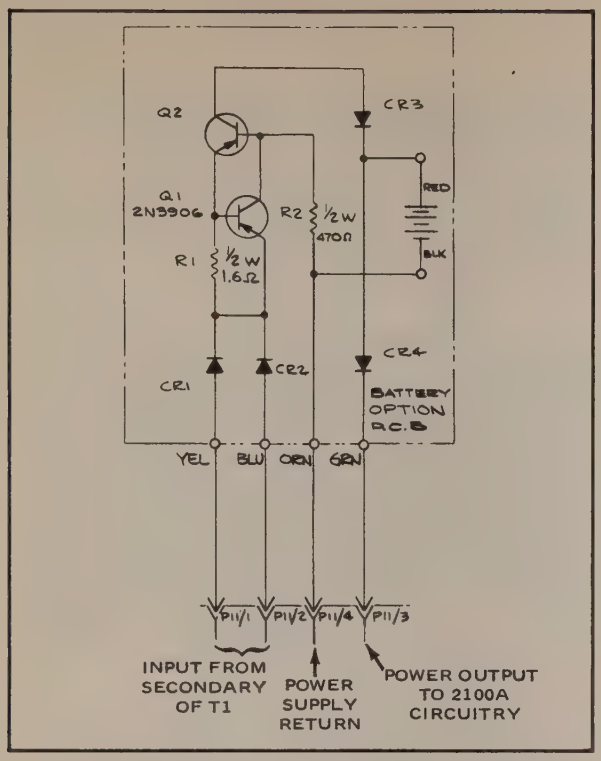


Figure 6-6. BATTERY CHARGING CIRCUIT

d. Remove four screws from the Main PCB to allow the four standoffs of the battery pack to set on the board (see Figure 6-7).

f; Secure the battery pack to the Main PCB by inserting the long screws (four supplied) down through each standoff into the Main PCB.

g. Plug the battery cable into J11 on the Main PCB.

h. Place the 2100A chassis back into the outer case.

6-47. Option –01 Battery Replacement

6-48. Use the following procedure for removing and replacing batteries.

CAUTION!

Do not attempt to use alkaline, zinc-carbon or mercury batteries in the 2100A.

a. Disconnect the line power cord. Remove the retaining screws from the rear of the instrument.case and remove the instrument from the case.

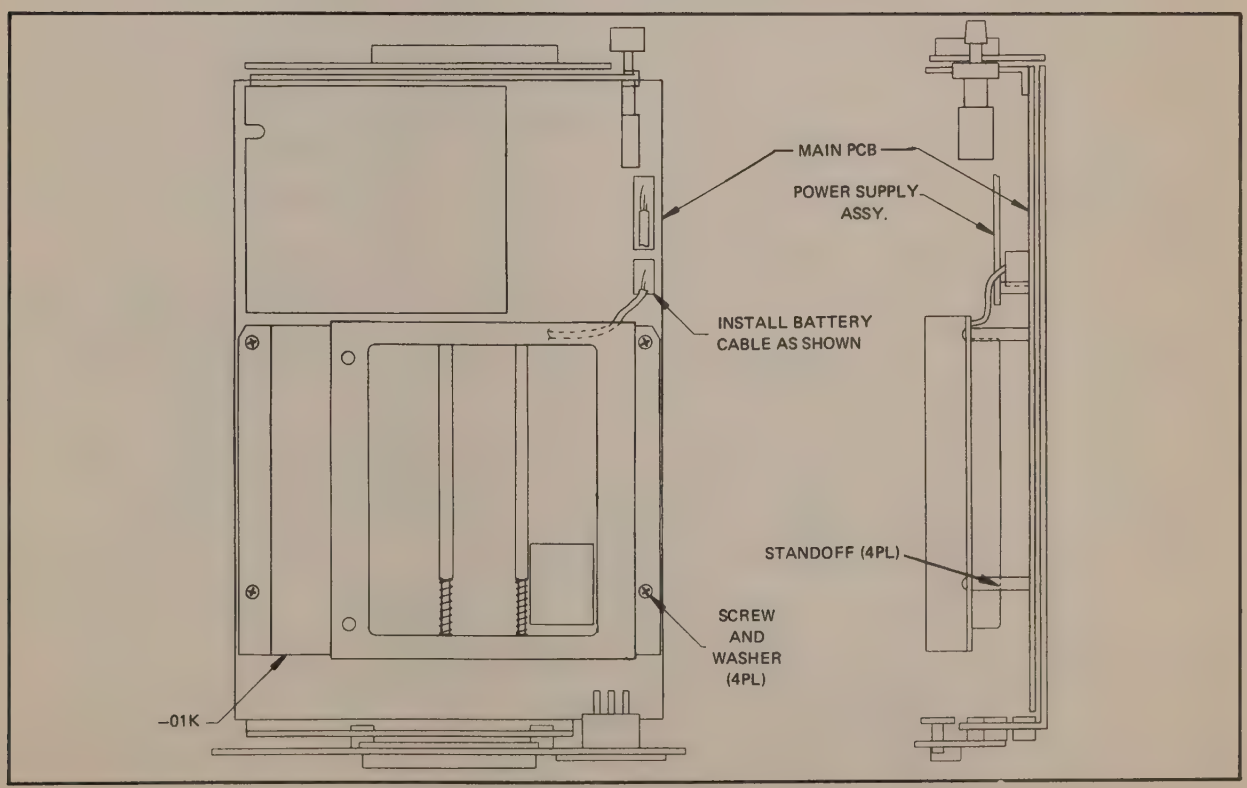


Figure 6-7. BATTERY PACK INSTALLATION

b. Remove the two spring-loaded battery retaining rods from the top of the battery pack and remove the batteries.

c. Replace the batteries with 1.2 volts, 2.3 ampere hour, nickel-cadmium (JF Part No. 370759). Install the batteries in the positions indicated by the molded forms in the battery tray.

6-49. OPTION–02, DIGITAL OUTPUT UNIT

6-50. Introduction

6-51. The Digital Output Unit (DOU) provides 2100A measurement data, in bcd format, at a rear panel output connector. The DOU options can be installed, either at the factory or in the field, in any of the three basic configurations of of the digital thermometer (2100A–03, 2100A–06, or the 2100A–10). The output data that can be available at the rear connector (some data changes with 2100A configuration) is presented in Table 6-2. The 2100A equipped with the DOU option can be connected to the Fluke Model 2010A Digital Printer to provide a printed record of temperature data.

6-52. Option –02 Specifications

6-53. The specifications pertaining to the Digital OUtput Unit are provided in Section I of this manual.

6-54. Option –02 Operation

6-55. DATA UPDATE

6-56. The data available at the DOU output connector can be updated upon command from an external source or allowed to automatically update once each 400 milliseconds. The data will be automatically updated when pin B (arm enable) of output connector J13 is pulled low (grounded). A commanded update is accomplished by leaving pin B high (open input) and pulling pin C (arm input) low (negative edge trigger) to request new data. The next complete data input from the 2100A will be applied to the DOU output connector. The arm input signal applied to pin C must be low for a minimum of 500 ns to insure that the output data will be updated.

Table 6-2. DOU INPUT/OUTPUT DATA

DATA	DOU CONNECTOR				DATA
+5V Ref		1	A		Ground
BUSY FLAG		2	B		Arm Enable
POLARITY		3	C		Arm Input
CHAN 10 (units)	(8)	4	D	(4)	CHAN 10 (units)
	(2)	5	E	(1)	
Open Thermocouple		6	F	(4)	Decimal Location
Decimal Location	(2)	7	H	(1)	
Digit 5	(8)	8	J	(4)	Digit 5
	(2)	9	K	(1)	
Digit 4	(8)	10	L	(4)	Digit 4
	(2)	11	M	(1)	
Digit 3	(8)	12	N	(4)	Digit 3
	(2)	13	P	(1)	
Digit 2	(8)	14	R	(4)	Digit 2
	(2)	15	S	(1)	
Digit 1	(8)	16	T	(4)	Digit 1
	(2)	17	U	(1)	
CHAN 1D (tens)	(8)	18	V	(4)	CHAN 10 (tens)
	(2)	19	W	(1)	
	°C	20	X		Ground
	°F	21	Y		Ground
	mV	22	Z		Ground

NOTES:

1. *Bit weights are shown in parenthesis.*
2. *Digit 1 is most significant.*
3. *Digit 5 is least significant.*
4. *Pins B and C, arm enable and arm input, have no wires in cable. Connections are available in the plug. Pin B, arm enable is normally tied low. See Figure 2.*
5. *A high on pin 6, open thermocouple, prints red.*

6-57. BUSY FLAG

6-58. The Busy Flag (J13 pin 2) is generated when new data is being applied to the DOU output connector. The output at J13 pin 2 can be selected to provide a high true indication (BUSY) or a low true indication ($\overline{\text{BUSY}}$)that new data is being applied to J13. (Refer to the installation instructions for logic level selection.) The output data on J13 is not valid while the Busy Flag is true.

6-59. Option –02 Theory of Operation

6-60. The DOU is separated by an isolation guard into two halves. One half receives binary coded data from the 2100A and serially passes the data across the guard to the second half. Circuitry in the second half will automatically, or upon command, apply the serial data to a series of shift registers which hold the input data and present it in parallel at the DOU output connector. Timing signals, generated by the 2100A, control the data transfer.

6-61. The three timing signals used to synchronize the data transfer in the DOU are: the Busy Flag (BZ) input on P7-8, the Register pulses (RG) input on P7-7, and Strobe Five (S5) input on P7-6. Figure 6-8 shows the relationship of these three signals. The BZ signal goes high for 2.5 ms (one series of strobe signals; ST0 through ST7) to indicate that new data has been loaded into the latches within the LSI chip (2100A–U1). The S5 signal that occurs while BZ is high starts the data transfer. The RG pulses then time the sampling of the four bit bcd word(s) applied to the DOU input lines. Refer to the Digital Output Unit schematic in Section 8 when reading the following theory.

6-62. When the BZ signal (P7-8) is high the S5 signal will clock U8 causing the Q output (DT signal) to go high. The DT (Data Transer) signal is applied to U11-6, U6-12, and U6-6; enabling them to pass the new input data across the GUARD to the DOU output shift registers. The S5 signal is also applied to pin 7 of dual shift register U12. The RG pulse input from P7-7 is applied to U12-9 to clock the S5 signal into the shift register. The RG pulse is also coupled across C1 to U8-4, causing the $\overline{Q}$ output (U8-2) to go low. This low output is applied to the input (U1-6) of a four pulse oscillator comprised of U1, R2, and C2. This oscillator produces four output pulses for each RG pulse input. The four pulses are inverted by U9-14 and applied to the clock inputs of dual JK Flip-Flop U5. The Q and $\overline{Q}$ outputs of U5 are connected tu U2 in such a way as to enable only one nand gate at a time. The enabled gate then opens the corresponding U3 data transfer gate; U3-13 first, then U3-5, then U3-12, and finally U3-6. The first three gate control signals, indicated as A, B, and C, are also applied to U11-12, U11-5, and U11-13 respectively.

6-63. Input data is applied to the DOU on one of two, four-bit parallel inputs (P7-2 thru 5 or P8-2 through 5) plus two three bit parallel inputs (P7-9, P7-10, and P8-7 or P8-8 through 10). The four bit data word transmitted on these lines during each strobe signal is presented in Table 6-3. The code for the decimal location is also provided. Bits of the parallel input data word are sampled one at a time so that the data word is transmitted across the guard in serial form.

6-64, During strobe five (S5), as indicated in Table 6-3, the data word for the decimal location will be present on DOU input lines P7-2 through 5. The four data transfer gates (U4-13, 5, 12, and 6) are opened by the inverted out-

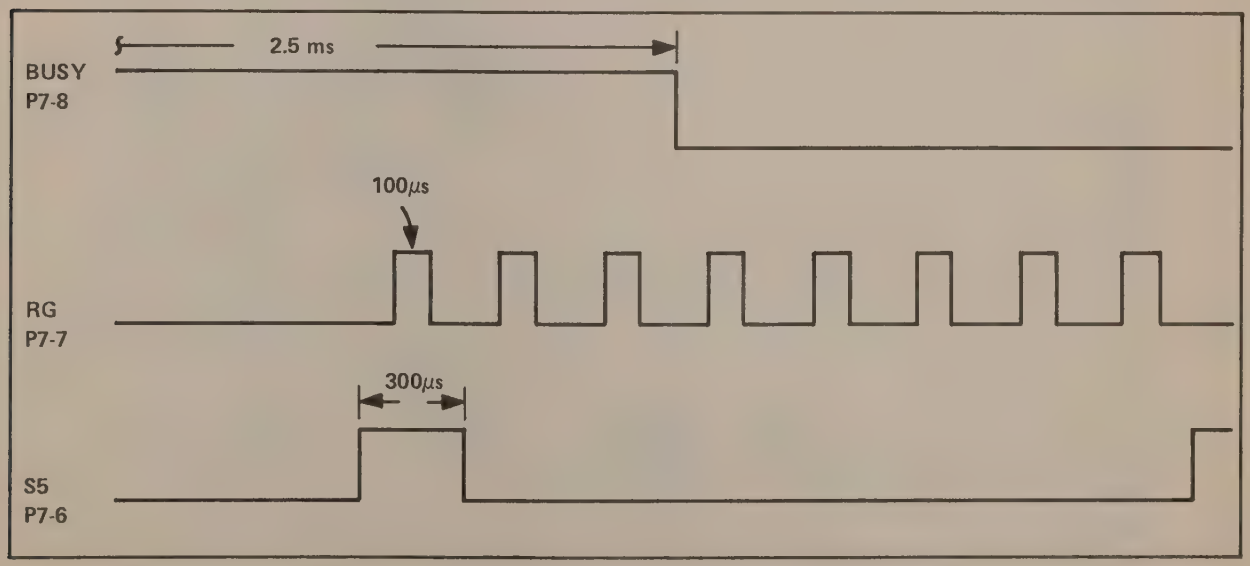


Figure 6-8. DOU TIMING SIGNALS

put signal of U12-10 and the data word is applied to data transfer gates U3-13, 5, 12, and 6. The four pulse generator in conjunction with U5 and U2 causes the U3 data transfer gates to open one at a time changing the paralled data word input to serial form for transfer across the guard. The data words of strobe six and strobe seven are transmitted across the guard in the same manner. During strobe zero, however, the output of U12-10 changes state, causing the data transfer gates of U4 to close and those of U7 to open. The data word present on P8-2 thru 5 during strobe zero is changed to serial form for transmission across the guard. The output of U12-10 again changes, at the end of strobe zero, to close the data transfer gates in U7 and reopen those in U4 for the remaining four strobe signals.

6-65. Due to the amount of data, two three bit data words, one during strobe three and one during strobe four, are transmitted across the guard by a separate path. At strobe three, the output of U12-11 will cause data transfer gates U13-13, U6-5, and U6-13 to open. At the end of strobe three, these gates close and strobe four (U12-2) will open gates U13–6, 5, and 12.

6-66. On the other side of the guard the serial data is loaded into shift registers so that all output data is presented in parallel form. The data is clocked into the shift registers by the output signal of the four pulse generator. The pulses are transmitted across the guard, via U16, and applied to U19-5 and U20-5. As long as the pulses are present at U20-5, the circuit, comprising Q4, R13, and C5, will hold U29-3 low. The resultant high output at U20-2 is inverted through U20-14 so that U19-2 will be held low for the duration of the data transfer. A low applied to U19-1 will cause a high output at U19-3. The high is inverted through U20-11 and applied to U19-6 to enable that gate to pass the clock pulses to the shift registers. The BUSY (U17-9) and $\overline{\text{BUSY}}$ (U17-11) are true as long as U19-6 is low.

6-67. The low input to U19-1 is generated to provide either automatic updating or command updating of the DOU output data. Automatic updating occurs when J13-B (ARM ENABLE) is pulled low. the low input is inverted through U16-14 and the resulting high is applied to U19–12 and U18-9. the output at U19-11 goes low which will enable U19-1. Command updating requries a high signal at U13-B (open input) which, when inverted through U17-14 will cause U18-9 to be low. The ARM INPUT signal at J13-C is an edge triggered command; i.e., the high to low transition, when inverted through U17-3, will clock U18-11. The resulting low output at U18-13 is applied to U19-9. The other input (U19-8) will be low when data is not being transmitted across the guard. (This insures that the DOU is not command-

Table 6-3. DOU INPUT DATA

DATA	CONNECTOR PINS				STROBE	CONNECTOR PINS				DATA
	P7-5	P7-4	P7-3	P7-2						
DECIMAL LOCATION	–	L	M	N	5					
3rd S. D.	8	4	2	1	6					
POLARITY	POL		$\overline{\text{POL}}$		7	P8-2	P8-3	P8-4	P80 5	
NO DATA	–	–	–	–	0	80	40	20	10	CHAN ID
4th S.D.	8	4	2	1	1					
MSD	8	4	2	1	2		P7-9	P7-10	P8-7	
LSD	8	4	2	1	3	–	OPEN THERM	mV DEGREE	CHAN ID , 8	
2nd SD	8	4	2	1	4		P8-8	P8-9	P8-10	
						–	4	2	1	CHAN ID

DECIMAL LOCATION	FUNCTION	CODE L M N
39.999	mV	1 0 0
399.99	mV	1 1 0
3999.9	DEGREE	0 0 1

ed to update the output in the middle of the data transfer.) When the output at U19-10 goes high both U18-8 and U18-6 are set. The high output from U18-1 is applied to U19-13 causing a low input at U19-1. The next data transfer will cause U19-2 to go low enabling the shift register clock pulses to pass through U19-5. At the end of the data transfer U20-15 will go high which clocks U18-3. The output at U18-1 goes low causing U19-11 to go high to disable U19-1 until a new ARM INPUT command is applied to J13-C.

6-68. Option –02 Installation

6-69, Use the following procedure to install the Digital Output Unit in the 2100A. Refer to Figure 6-9 for item locations:

a. Remove the 2100A from the outer case.

b. Remove four screws from the Main PCB to allow the four standoffs of the DOU to set on the Main PCB.

c. Position the DOU on the Main PCB as shown in Figure 6-9.

d. Insert the DOU flexible land connectors P7 and P8 into J7 and J8 on the Main PCB.

e. Secure the DOU to the Main PCB by inserting the long screws (four supplied) down through each standoff into the Main PCB.

f. Install the polarity (POL or $\overline{POL}$) and busy (BZ or $\overline{BZ}$) jumpers to obtain the desired high true or low true logic.

g. Install the two degree selection jumpers to provide either Celsius or Fahrenheit operation.

h. Install the 2100A back into the outer case.

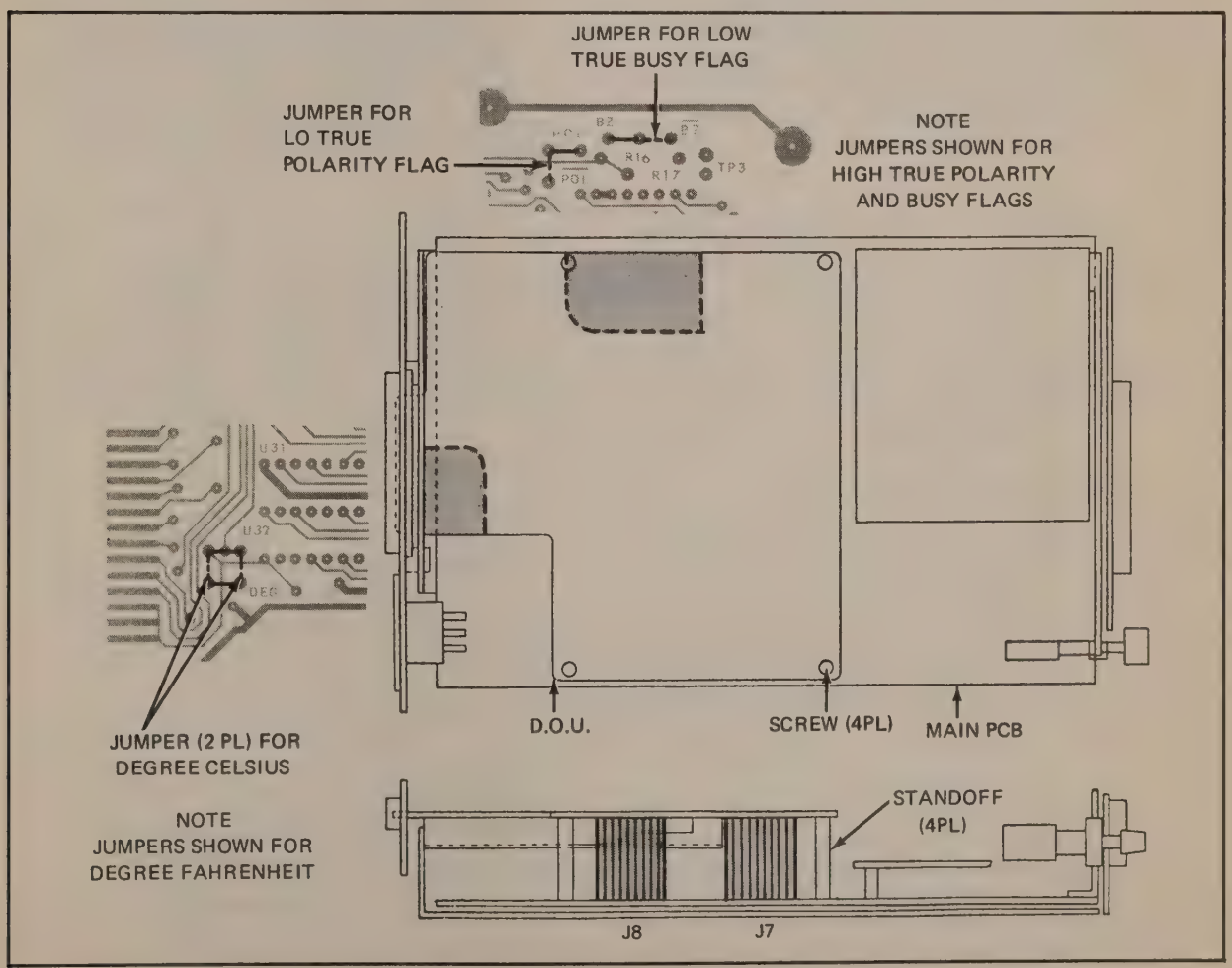


Figure 6-9. DOU INSTALLATION ILLUSTRATION

6-70. ANALOG OUTPUT UNIT, OPTION –04

6-71. Introduction

6-72. The Analog Output Unit (AOU) is a field installable pcb assembly which provides the 2100A with a rear panel analog output voltage proportional to the displayed temperature. Provisions are included for zeroing or offsetting the output voltage anywhere within the full scale capability (00000 to 39999) of the 2100A. This feature allows the operator to establish a convenient reference for use with external recording devices, such as, a strip-chart recorder.

6-73. The actual output voltage generated by the AOU is isolated from the measurement circuitry of the 2100A and covers a voltage range of –4 to +4V dc. The output voltage is directly proportional to the displayed temperature when the offset feature is not enabled. For example, a displayed temperature of +125.7 degrees would produce a voltage of +0.1257V dc at the output terminals of the AOU.

6-74. The offset feature covers the full-scale measurement capability of the 2100A in four separate ranges to provide optimum resolution when establishing an offset reference. The offset ranges are: 0 to 1V dc, 1 to 2V dc, 2 to 3V dc, and 3 to 4V dc. The offset voltage is variable over the entire selected range.

6-75. Specification

6-76. Specifications for the Analog Output Unit (Option –04) are provided in Section 1 of this manual.

6-77. Installation

6-78. Use the following procedure to install the Analog Output Unit in the 2100A. Refer to Figure 6-10 for the location of items referenced in the procedure:

a. Remove the 2100A from its outer case.

b. Remove the four mounting screws from the main pcb.

c. Remove the two screws that hold the upper rear panel of the 2100A in place and push out the plastic insert.

d. Connect the five color-coded leads from the AOU to the appropriate pins on the main pcb.

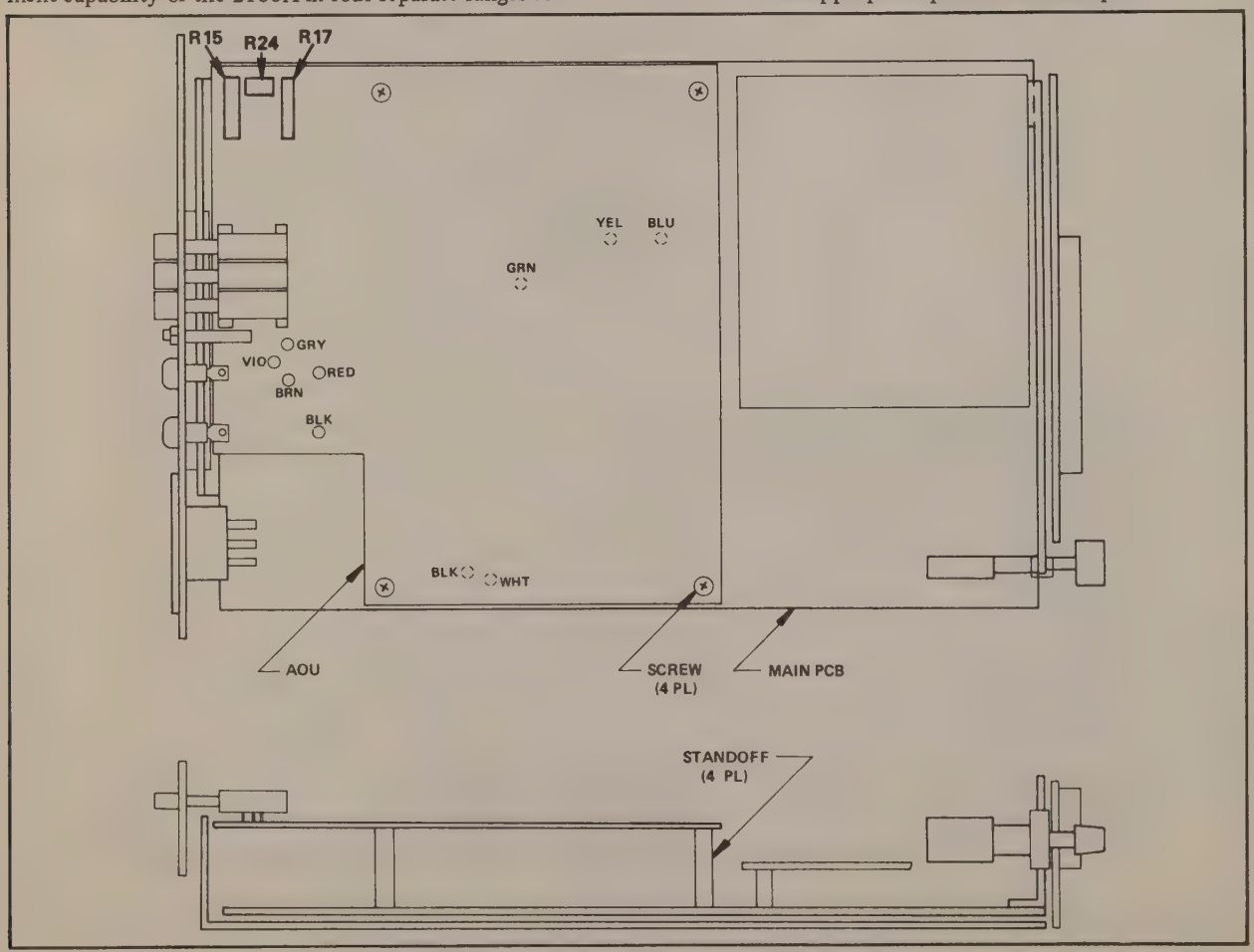


Figure 6-10. AOU INSTALLATION DETAIL

e. Position the AOU on the main pcb as shown in Figure. 6-9.

f. Secure the AOU to the main pcb by inserting the four long screws down through each stand-off and into the main pcb.

g. Place the 2100A rear panel back into position allowing the AOU push-button switches to protrude through the slot.

h. Position the AOU rear panel over the switches and install the two screws to hold the panel in place.

i. Connect the five color-coded leads from the AOU rear panel to the AOU pcb as indicated in Figure 6-9.

j. Install the 2100A in its outer case.

NOTE

If pins are not present on the pcb, install the pins provided with the AOU kit in the color coded positions etched on the main pcb. Some earlier models do not have provisions for installing these pins. Call your local service center or contact the John Fluke Mfg. Co., Inc. in this event.

6-79. OPERATION

6-80. Once installed in the 2100A, the AOU requries no operator attention other than checking to insure that the rear panel offset switches are properly positioned, and, if necessary, adjusting the offset voltage. If an offset is not required, set switch S1 to the OUT position. If required, use the following procedure to adjust the offset:

NOTE

Use of the offset feature is optional and is only required when it is necessary to display a small temperature band (about some larger temperature) on the external monitor (recorder).

a. Energize the 2100A and connect the desired thermocouple to the input terminals.

b. Expose the thermocouple to a temperature which approximates the typical temperatures to be encountered by the probe. This temperature must fall within the temperature band to be displayed by the external monitor.

c. Observe the 2100A display and select the AOU range switch combination which covers the display temperature. For example, if the display reads +1257-2°, select the switch combination that will allow a 1.2572 volt offset, i.e., the 1.0 to 2.0V range.

NOTE

The switch combinations required to select a particular offset voltage range are defined on the AOU rear panel.

d. Connect the monitor to the AOU and adjust the AOU OFFSET ADJ pot on the 2100A rear panel until the monitor indication represents the displayed temperature.

NOTE

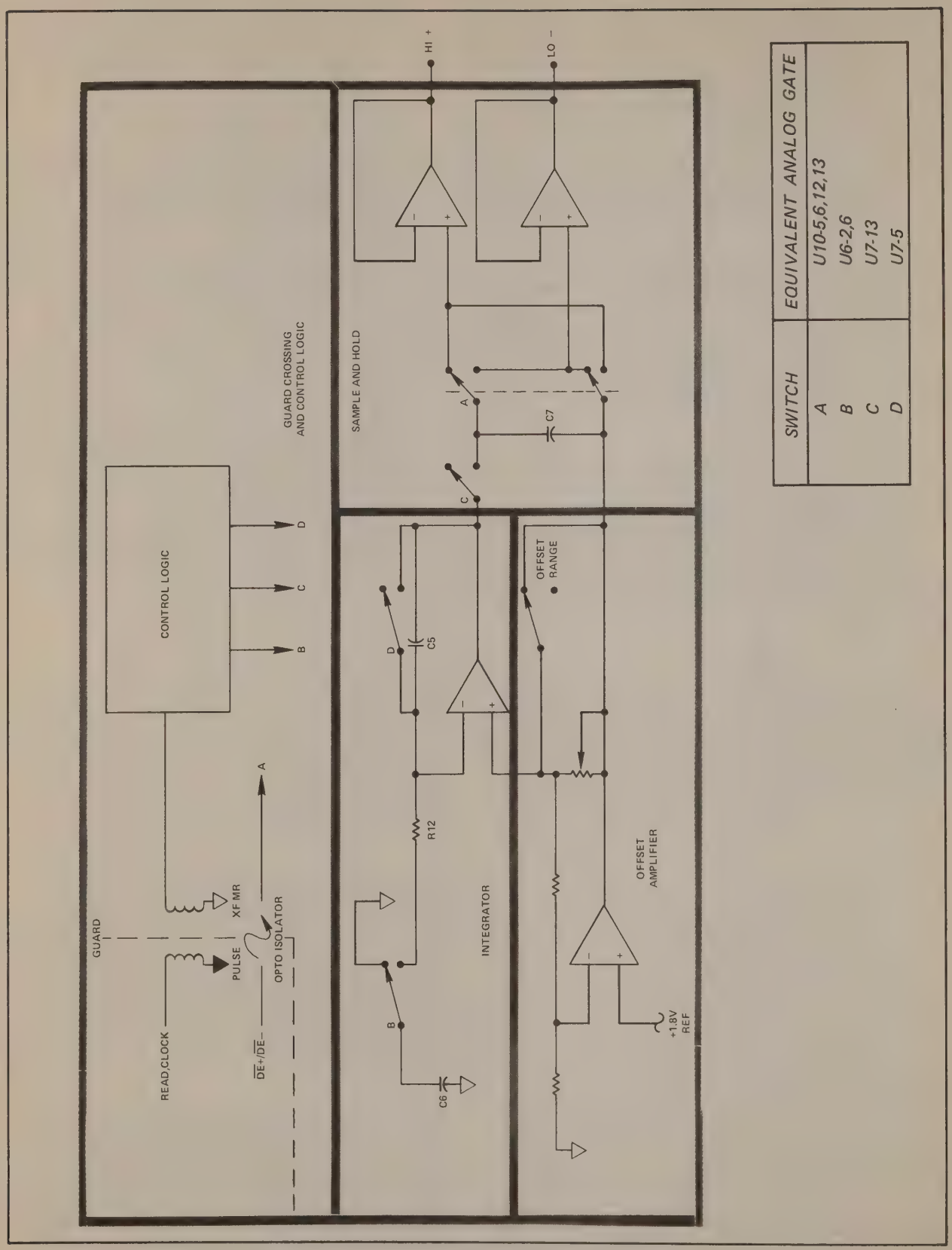
The AOU output voltage is offset by a voltage within the selected range and is dependent upon the position of the OUTPUT ADJUST pot. The resultant AOU output is equal to A-X. Where: A is the AOU output with S1 in the OUT position, and X is the offset voltage selected by the offset range switches and the OFFSET ADJ pot (When A is negative, the AOU output is A + X).

6-81. Theory of Operation

6-82. The function of the AOU is to convert the read clock from the 2100A into an analog output voltage which is proportional to the displayed temperature. Control signals and operating power for the AOU are transferred through a guard crossing to ensure isolation between the 2100A inputs and the AOU outputs. A functional block diagram of the AOU is given in Figure 6-11 and a timing diagram for the AOU is shown in Figure 6-12.

6-83. Input data to the AOU is received in the form of the read clock and the $\overline{DE}$ + $\overline{DE}$ – reference command, both of which are generated during the 2100A read period. The read clock is coupled across the guard to the Control Logic where it is conditioned for use in driving analog gates B, C and D (shown in Figure 6-11 as switches). The $\overline{DE}$ + and $\overline{DE}$ – signals are also coupled across the guard and used to operate the polarity analog gate (switch A). Initial operation begins with switches A, B, C and D in the positions shown.

6-84. At the end of the read period, the appropriate polarity command is received at the AOU and switch A is positioned to provide either a positive ($\overline{DE}$+) or a negative ($\overline{DE}$ –) analog output voltage. As the 1 MHz read clock is received at the control logic, it is divided-by-four and the resulting 250 kHz pulse is used to toggle switch B in the Integrator circuit. The toggle action at switch B causes capacitor C6 to be charged through R12 and then



SWITCH	EQUIVALENT ANALOG GATE
A	U10-5,6,12,13
B	U6-2,6
C	U7-13
D	U7-5

Figure 6-11. AOU FUNCTIONAL BLOCK DIAGRAM

discharged to ground. This alternate charge/discharge process causes the integrator to accumulate a charge at C5 which is proportional to the number of pulses generated during the read period. The charge rate of C5 is determined by the reference voltage at the + input of the integrator amplifier and the value of C6. Hence, the voltage across capacitor C5 is proportional to: $\propto$ (V ref $\div$ C5) C6. The integrator output, with respect to TP3 (common), starts at about +3 volts for a 00000 reading and increses to approximately +7.0V dc for a full-scale (39999) 2100A reading.

6-85. In addition to providing a reference voltage for the Integrator circuit, the Offset Amplifier provides the adjustable voltage used to offset the final AOU output. The Offset Amplifier is a standard positive-gain amplifier with range resistors which are manually selected and adjusted to determine offset amplitude. A +1.8 volt source derived from the +10 volt operating supply is used as a reference input to the Offset Amplifier.

6-86. At the end of the read period, the read clock and switch B are stopped and C5 is charged to a voltage porportional to the 2100A reading. At this time a 4 ms pulse is generated by the Control Logic to close switch C. During this period, the differential output of the Integrator and the Offset Amplifier is connected to Capacitor C7, and delivered through polarity switch A to the AOU output terminals. At the end of the 4 ms period, switch C opens and capacitor C7 maintains the AOU output until it is updated following the next read period.

6-87. Calibration

6-88. The Analog Output Unit is calibrated after the basic 2100A has been calibrated. The required equipment includes the voltmeter and DC voltage calibrator defined in Section 4, Table 4-1. The following calibrations procedure assumes that the AOU is installed in the 2100A.

a. Remove the reference junction jumper from the 2100A. See Figure 4-2.

b. Connect the AOU output terminals (HI, LO) to the DVM inputs.

c. Short circuit the inputs of the 2100A.

d. Short circuit TP1 to TP2 on the AOU.

e. For units equipped with Option –06, select the 400 mV range.

f. Set tall AOU offset range switches (S1, S2, and S3) to the out position.

g. Adjust R24 (Internal Offset) on the AOU for 0 $\pm$ 50 uV ont he DVM. See Figure 6-9. The DVM should be on the lowest dc voltage range with filter out.

h. Remove the short circuit from TP1 and TP2.

i. Remove the short circuit from the 2100A input.

j. Set the output of the DC voltage calibrator to 0V and connect it to the 2100A inputs.

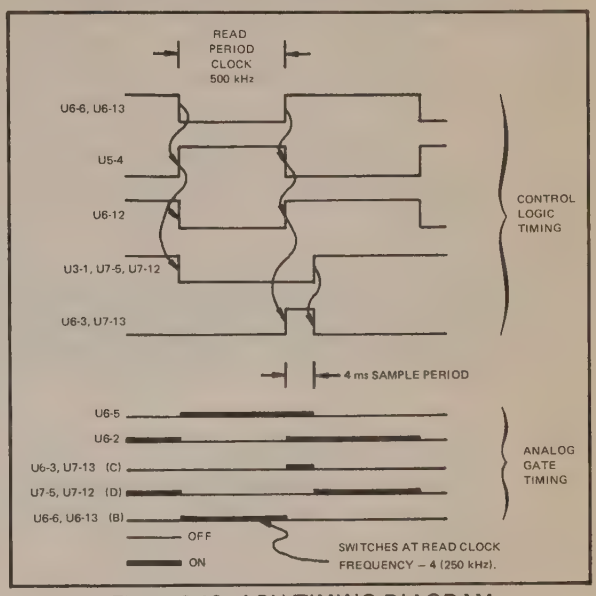


Figure 6-12. AOU TIMING DIAGRAM

k. Adjust the DC voltage calibrator to obtain +00001 reading on the 2100A. Then reduce the input voltage to obtain a solid +00000 reading, i.e., the 2100A should not flash either a 1 or a minus sign.

l. Adjust R17 (Zero Offset) for a 0 $\pm$150 μV dc indication on the DVM.

m. Reverse the inputs to the 2100A. If the DVM does not indicate 0 $\pm$150 μV dc, repeat steps c through m.

n. Refer to Table 6-4 , and select the thermocouple type that corresponds to the type used by the 2100A being calibrated. If the 2100A includes the –06 option, select the 400 mV range.

o. Adjust the output of the DC Voltage calibrator to provide a 2100A input that corresponds to the thermocouple type selected in step n.

p. Adjust R15 (Full Scale Calibration) to provide a DVM reading within the limits given in Table 6-4 . If the R15 adjustment is insufficient, solder a shorting bar across R26 (402Ω $\pm$1%).

q. Repeat steps j through p until both zero and full scale readings are within limits. (This compensates for interaction between R17 and R15.)

NOTE

Steps r through x are necessary only if the AOU has been recently repaired or there is other reason to question the operation of the variable offset.

r. Short circuit the 2100A input.

s. Refer to the chart on the rear of the AOU and select the switch combination for the 0.0 to 1.0V offset range.

t. Adjust the rear panel OFFSET ADJ pot (R20) for a minimum reading on the DVM. The reading should be ⩽ 0.01V dc as shown in the low limit column of Table 6-5.

u. Sequentially select the three remaining offset voltage ranges and check the DVM reading for each to ensure that it is within the low limit listed in Table 6-5.

v. Select the 0.0 to 1.0V offset range on the AOU and adjust R20 for a maximum reading on the DVM. The reading should be ⩾ +1.001V dc as shown in Table 6-5.

w. Sequentially select the three remaining offset voltage ranges and check the DVM reading for each to ensure that it meets or exceeds the high limit listed in Table 6-5.

x. Install the reference junction jumper removed earlier in this procedure.

Table 6-5. OFFSET VOLTAGE RANGE LIMITS

OFFSET VOLTAGE RANGE	LOW LIMIT ⩽	HIGH LIMIT ⩾
0.0 – 1.0V	–0.01V	+1.001V
1.0 – 2.0V	+0.999V	+2.001V
2.0 – 3.0V	+1.999V	+3.001V
3.0 – 4.0V	+2.999V	+4.001V

Table 6-4. AOU FULL-SCALE CALIBRATION (R15)

THERMOCOUPLE TYPE	2100A		AOU OUTPUT, V dc
	INPUT IN mV	DISPLAY	
J °F	+42.919	1374.9 ± 1	1.3695 to 1.3803
K°F	+53.633	2400.0 ± 1	2.3920 to 2.4080
T°F	+20.868	732.3 ± 1	0.7285 to 0.7361
E°F	+77.712	1840.0 ± 1	1.8334 to 1.8466
R°F	+20.917	3175.0 ± 3	1.5815 to 1.5934
S°F	+18.553	3175.0 ± 3	1.5815 to 1.5934
J °C	+42.919	760.0 ± 1	0.7561 to 0.7639
K°C	+55.833	1400.0 ± 1	1.3945 to 1.4045
T°C	+20.868	400.0 ± 1	0.3970 to 0.4030
E°C	+73.355	960.0 ± 1	0.0556 to 0.9644
R°C	+21.096	1767.0 ± 1	0.8803 to 0.8867
S°C	+18.704	1768.6 ± 1	0.8811 to 0.8875
400 mV	+390.00	390.00 ± 1	3.8703 to 3.9298

6-89. 2150A MULTIPOINT SELECTOR SWITCH

6-90. Introduction

6-91. The 2150A is an accessory to the 2100A that provides input connections for additional thermocouples. This accessory is compatable with all 2100A configurations. Three configurations of the 2150A provide switch selectable input connections for ten thermocouples (2150A-10), twenty thermocouples (2150A–20), or thirty thermocouples (2150A–30). Two or three 2150A units can be connected in series to obtain as many as ninty additional input connections.

6-92 Connection for Operations

6-93. Thermocouple connections to the 2150(s) and point selection, for display on the 2100A, are explained in the following procedure.

a. Remove the rear panel cover from the 2150 (s).

b. Slide the lower pcb out of the 2150A case and make the thermocouple connections (see Figure 6-13.)

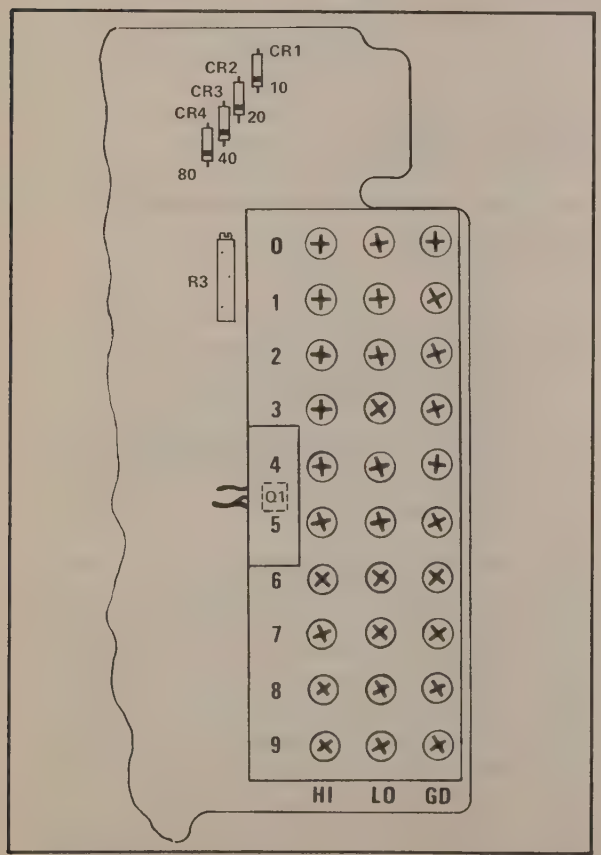


Figure 6-13. THERMOCOUPLE CONNECTIONS AND CALIBRATION ADJUSTMENT LOCATIONS

NOTE

The first metal of the thermocouple, as indicated on the 2100A front panel decal, connects to the HI terminal; the second metal, to the LO terminal If the thermocouple has a shield lead connect it to the GD (guard) terminal; if not, short the LO terminal to the GD terminal

c. Make the thermocouple connections to the middle pcb next, and the top pcb last.

6-94. The 2150A is connected to the 2100A via a ribbon cable that allows the two units to sit side-by-side or be stacked. Use the following procedure to connect the 2150A to the 2100A. Any difference in procedure related to the 2100A configuration (i.e., 2100A–03, 2100A–06, or 2100A–10) will be noted.

a. Remove the rear cover from the 2150A.

b. (1) (2100A–03 or 2100A–06)

Remove the lower rear panel of the 2100A by removing the three encircled screws and disconnecting the flex cable connector.

b. (2) (2100A–10)

Loosen the thumb screw from the rear panel (center) of the 2100A and slide the lower half of the chassis out about four inches.

c. Connect the supplied interconnect cable to the 2150A board edge connector (s) as shown in Figure 6-14. (One connection for the 2150A–10, two for the 2150A–20, and three for the 2150A–30.)

d. (1) (2100A–03 or 2100A–06)

Connect the other end of the interconnect cable to the board edge connector described as (–03 or –06 CONNECTION) in Figure 6-14.

d. (2) (2100A–10)

Connect the other end of the interconnect cable to the board edge connector described as (–10 CONNECTION) in Figure 6-14.

NOTE

Do not reconnect the flex cable of the 2100A–03 or 2100A–06 disconnected in step b(1). Bend the flex cable perpendicular to the lower rear panel before reinstallation.

e. Replace the rear panels of the 2150A and 2100A in Figure 6-14.

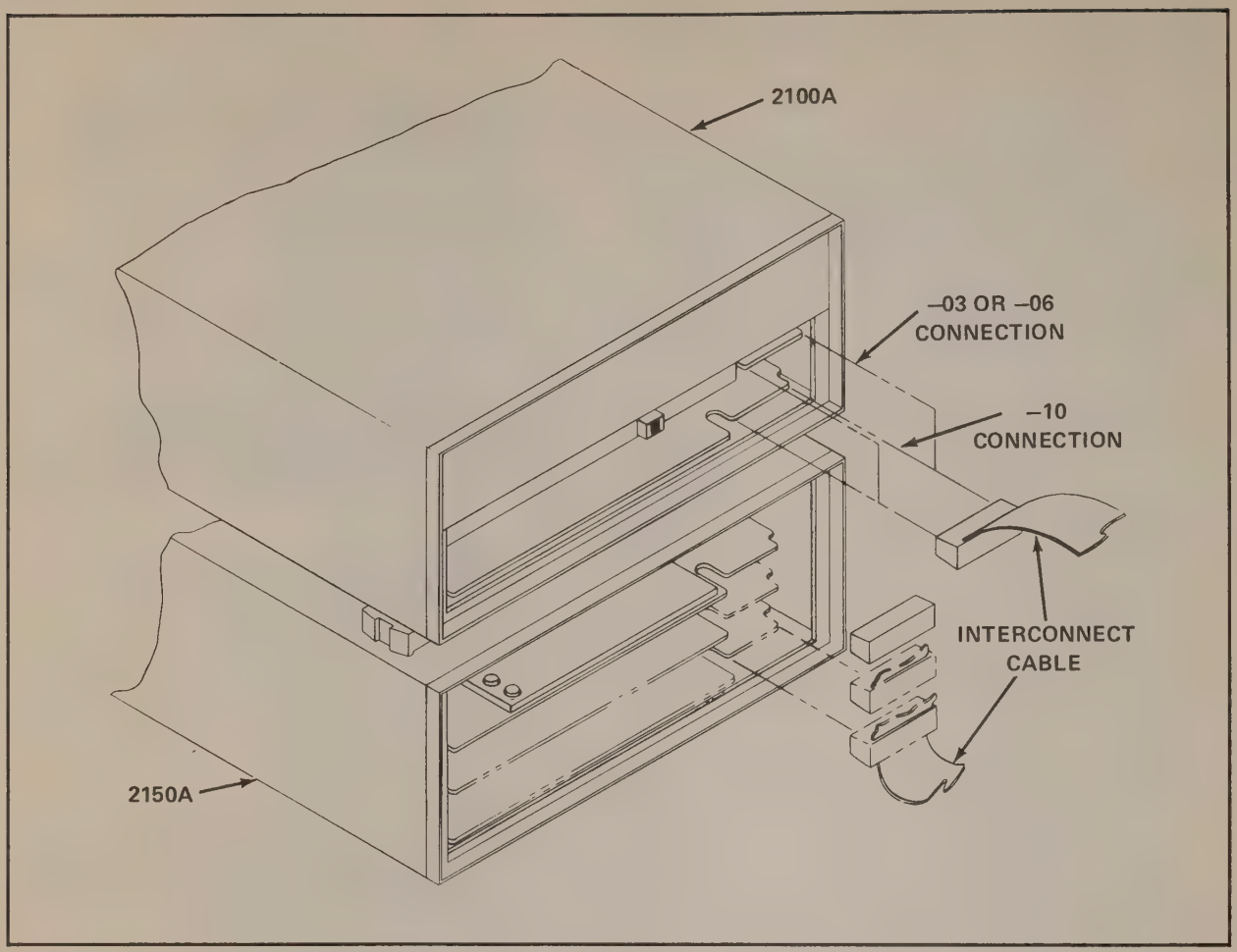


Figure 6-14. 2150A - 2100A INTERCONNECTION

6-95. Series connection of two or three 2150A instruments is described in the following procedure.

a. Remove the rear panels from the 2150A's

b. Connect one end of the interconnect cable to the board edge connectors (see Figure 6-14.) on one 2150A.

c. Slide the upper board of the second 2150A out of the case.

d. Connect the free end of the interconnect cable to the board edge connector at the front end of the board removed in step c.

e. Place the upper board back into the 2150A.

NOTE

Connecting a third 2150A to the second is done in the same manner as described above.

f. Attach the series connected 2150A units to the 2100A following the same procedure used to connect a single 2150A.

6-96. When the 2150A is used with a 2100A, equipped with the –02 option (DOU). the channel identification of each decade is determined by selecting and removing the proper diodes from the 2150A pcbs. Figure 6-10 shows the four channel identification diodes, CR1, CR2, CR3 and CR4, which correspond to decades 10, 20, 40, and 80 respectively. Identification of each decade of the 2150 is accomplished in a binary coded manner. To identify the units decade, leave all diodes in place, identify the tens decade by removing CR1, the twenties decade by removing CR2, the thirties decade by removing both CR1 and CR2, and so on until the diodes of each pcb have been selected to provide the proper channel identification code.

6-97. Operational Evaluation

6-98. Correct operation of the combined 2100A and 2150A(s) is determined by comparing the temperature indicated by an accurate calibration thermometer (Princo ASTM-56C). At least one input point in each decade of inputs should be checked to insure correct operation of the 2150A (s). Use the following procedure for the operational evaluation of the 2100A/2150A (s) configuration.

NOTE

Insure that the 2100A is within the calibration limits as specified in Section 4.

a. Attach one thermocouple to the 0 position input terminals in each decade of the 2150A (s).

b. Place the 2100A/2150A (s) and thermocouples in a room temperature (20°C to 26°C) environment protected from drafts that may cause short term instabilities in the temperature.

c. Place the calibration thermometer next to the thermocouples.

d. Energize the 2100A and allow one-half hour for the instrument to stabilize.

e. Press the 0 POINT select switch of each decade (one at a time) and observe the 2100A display for a temperature indication approximately equal to that indicated by the calibration thermometer.

NOTE

Since the absolute accuracy of the temperature reading depends upon the 2100A instrument type (–03, –06, or –10) and thermocouple type (J, K, E, R, or S) plus the 2150A, the operational evaluation checks for a close approximation of equal temperature indication not an absolute accuracy.

6-99. Calibration

6-100. The 2100A(–03, –06, or –10) and 2150 (s), with attached thermocouple type, must be calibrated as a system in order to assure maximum absolute temperature display accuracy. For this reason it is recommended that the 2150A be adjusted to fit the particular 2100A it is to be used with. Use the following procedure to adjust the 2150A (s).

a. Connect the 2150A (s) to the 2100A.

b. Place the thermocouple of the appropriate type (for the 2100A-06 also press the corresponding type select switch) and the calibration thermometer into a temperature lag bath at room temperature (20° C to 26°C).

c. Connect the thermocouple to the 0 POINT to each decade of the 2150A. (Allow about two minutes for the system to stabilize before going on to step d.

d. Adjust R3, on the 2150A pcb to which the thermocouple is connected, for a 2100A display equal to the temperature indicated by the calibration thermometer plus or minus 0.1° Celsius or Fahrenheit.

e. Connect the thermocouple to each decade of the 2150A(s), and wait two minutes, then adjust the corresponding R3 for a 2100A display within 0.1° of the calibration thermometer indication.

NOTE

The CANCEL switch of the completed decade must be pressed and the POINT selection switch, corresponding to the thermocouple location on the next decade, must also be pressed.

Section 7
General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(-) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
SI	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

Federal Supply Codes for Manufacturers (cont)

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

Federal Supply Codes for Manufacturers (cont)

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

Federal Supply Codes for Manufacturers (cont)

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts, Div. of
Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

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Fluke Technical Center
West 75th Century Road
Paramus, NJ 07652
(201) 262-9550

TX, Dallas
Fluke Technical Center
14400 Midway Road
Dallas, TX 75240
(214) 233-9945

WA, Everett
Fluke Technical Center
6920 Seaway Blvd.
Everett, WA 98206
(206) 356-5560

ALB, Calgary
Allan Crawford Assoc., Ltd.
#14 1935 30th Ave. N.E.
Calgary, Alberta T2E 6Z5
(403) 230-1341

ONT, Mississauga
Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ontario 1.4V IJ2
(416) 678-1500

QUE, Montreal
Allan Crawford Assoc., Ltd.
7018 Cote de Liesse
Montreal, Quebec H4T IE7
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Mr. Waverly, VIC 3149
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Brisbane, Queensland 4001
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Elektronische Gerate GmbH & Co.
Vertriebs-KG., Obachgasse 28
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1140 Brussels, Belgium
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Al. Amazonas 422, Alphaville, Barueri
CEP 06400 Sao Paulo, Brazil
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Casilla 16228
Santiago 9, Chile
Tel: 44940

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Beijing Radio Research Institute
Dianmen East Avenue 89
Beijing, China
Tel: 445612

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Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aero 29583
Bogota DE, Colombia S.A.
Tel: 232-45-32

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DK-2750 Ballerup
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78530 BUC, France
Tel: 09-33-1-9568131

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Hellenic Scientific
Representations Ltd.
11, Vrassida Street
Athens 612, Greece
Tel: 09-30-1-711140

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28th Fl. Wing On Centre
111 Connaught Road
Central Hong Kong
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Bombay 400 006, India
Tel: 811316

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Seoul, Korea
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Col. San Rafael
Delegacion Cuahutemoc
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3600 AE Maarssen, The Netherlands
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McLean Information Technology Ltd.
P.O. Box 18065
Glen Innes
Auckland 6, New Zealand
Tel: 587-037

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Morgenstierne & Co. A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 09-47-2-356110

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Pak International Operations
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Karachi-2 Pakistan
Tel: 221127/239052

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Importaciones Y Representaciones
Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650

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P.O. Box 610 Greenhills
Metro Manila, Philippines 3113
Tel: 78-78-16

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Equipamentos de Laboratorio, Ltda.
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Lisbon 1000, Portugal
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Tel: 09-34-1-6194108

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Teleinstrument AB
P.O. Box 4490
S-162 04 Vallingby 4
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Tel: -09-46-8-380370

Switzerland
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich
Switzerland
Tel: 09-41-1-2010711

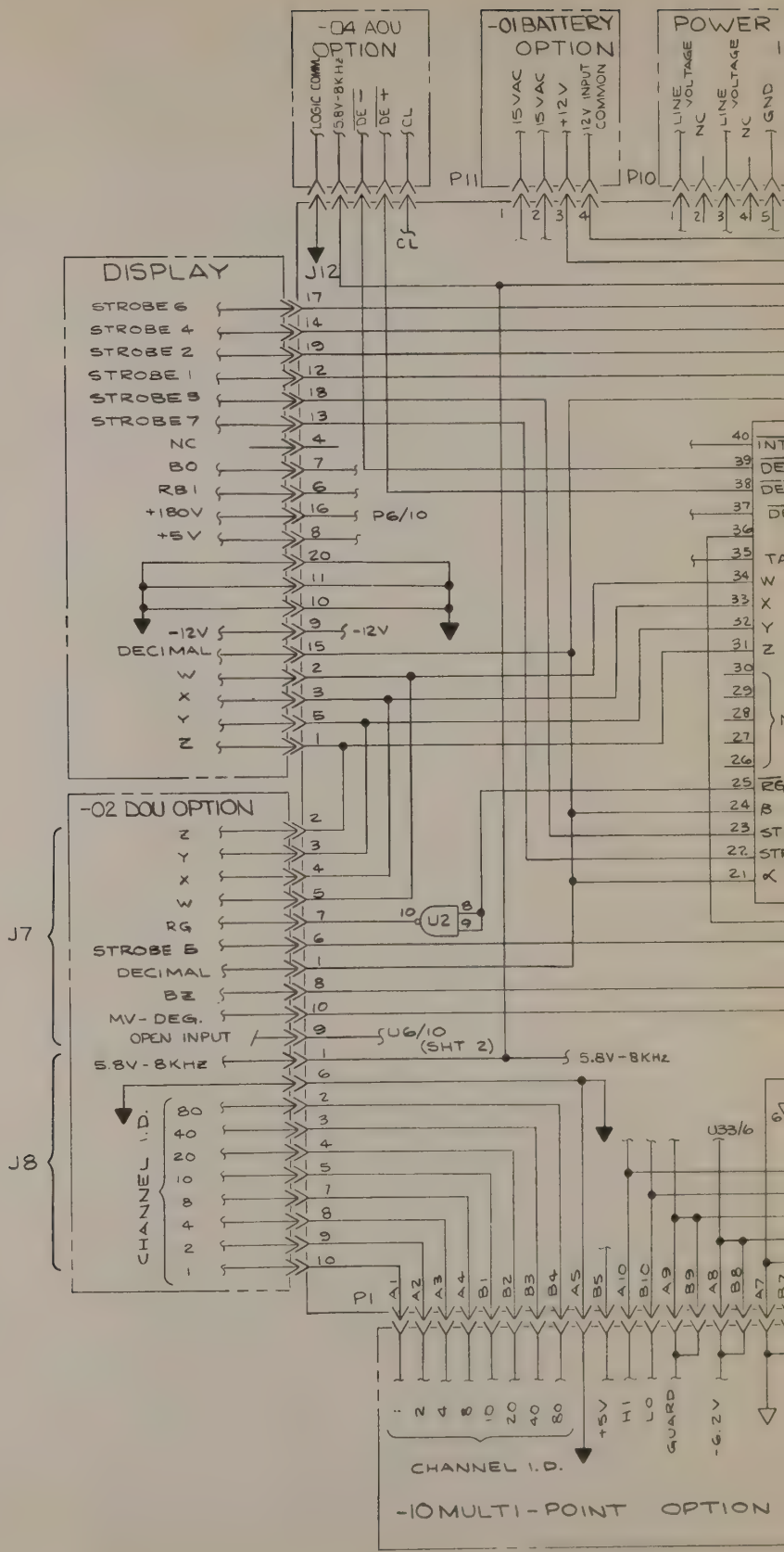
FLUKE®

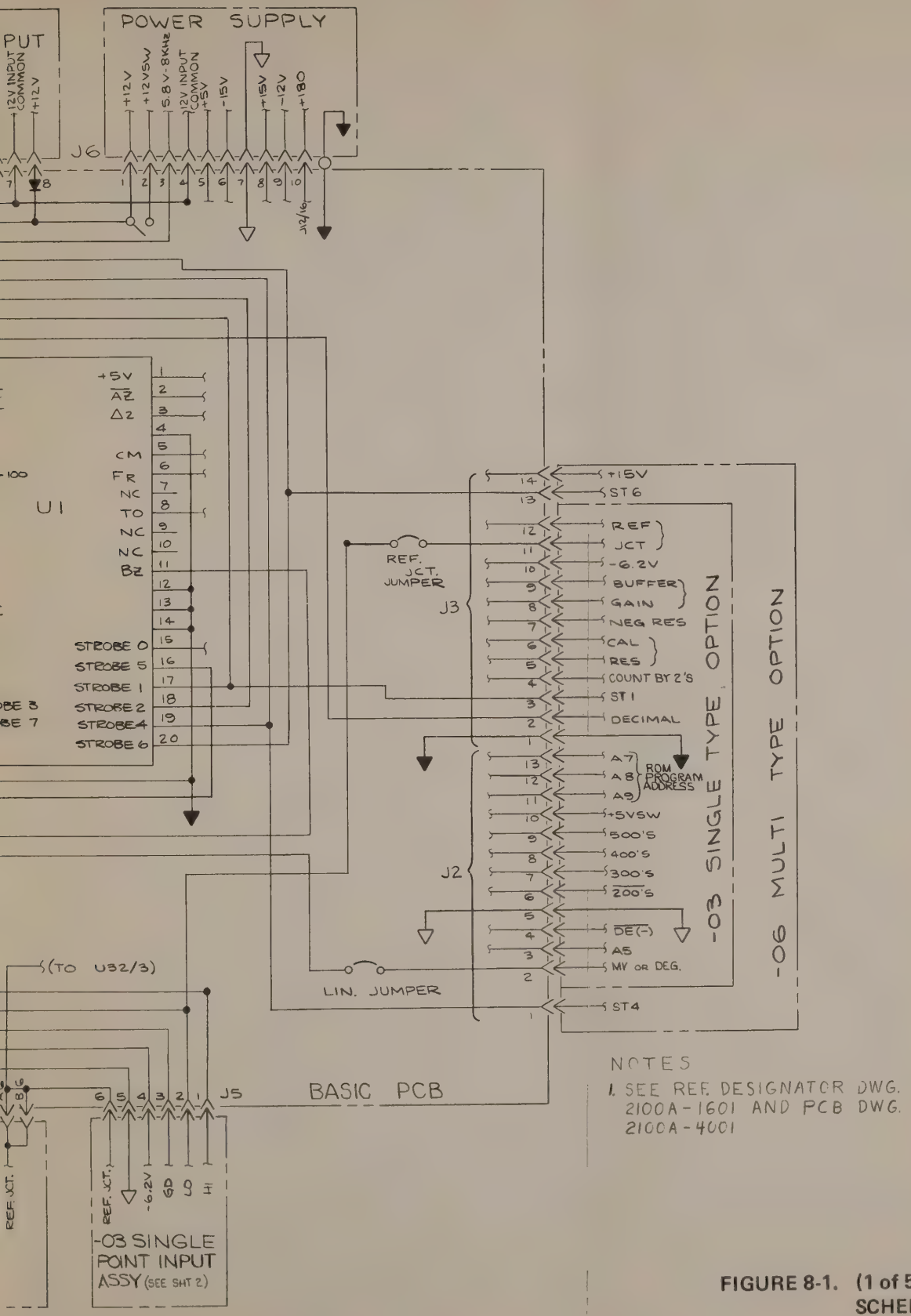
John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973

Litho in U.S.A. 12/81

Section 8
Schematic Diagrams

FIGURE NO.	NAME	DRAWING NO.	PAGE
8-1	Basic Instrument Schematic	2100A-1201	8-3
8-2	Single Type PCB Schematic	2100A-1210	8-8
8-3	Multi-Type PCB, °F Schematic	2100A-1205	8-9
8-4	Multi-Type PCB, °C Schematic	2100A-1222	8-10
8-5	Multi-Point PCB Schematic	2100A-1208	8-11
8-6	Data Output Unit Schematic	2100A-1207	8-12
8-7	Analog Output Unit	2100A-1226	8-13

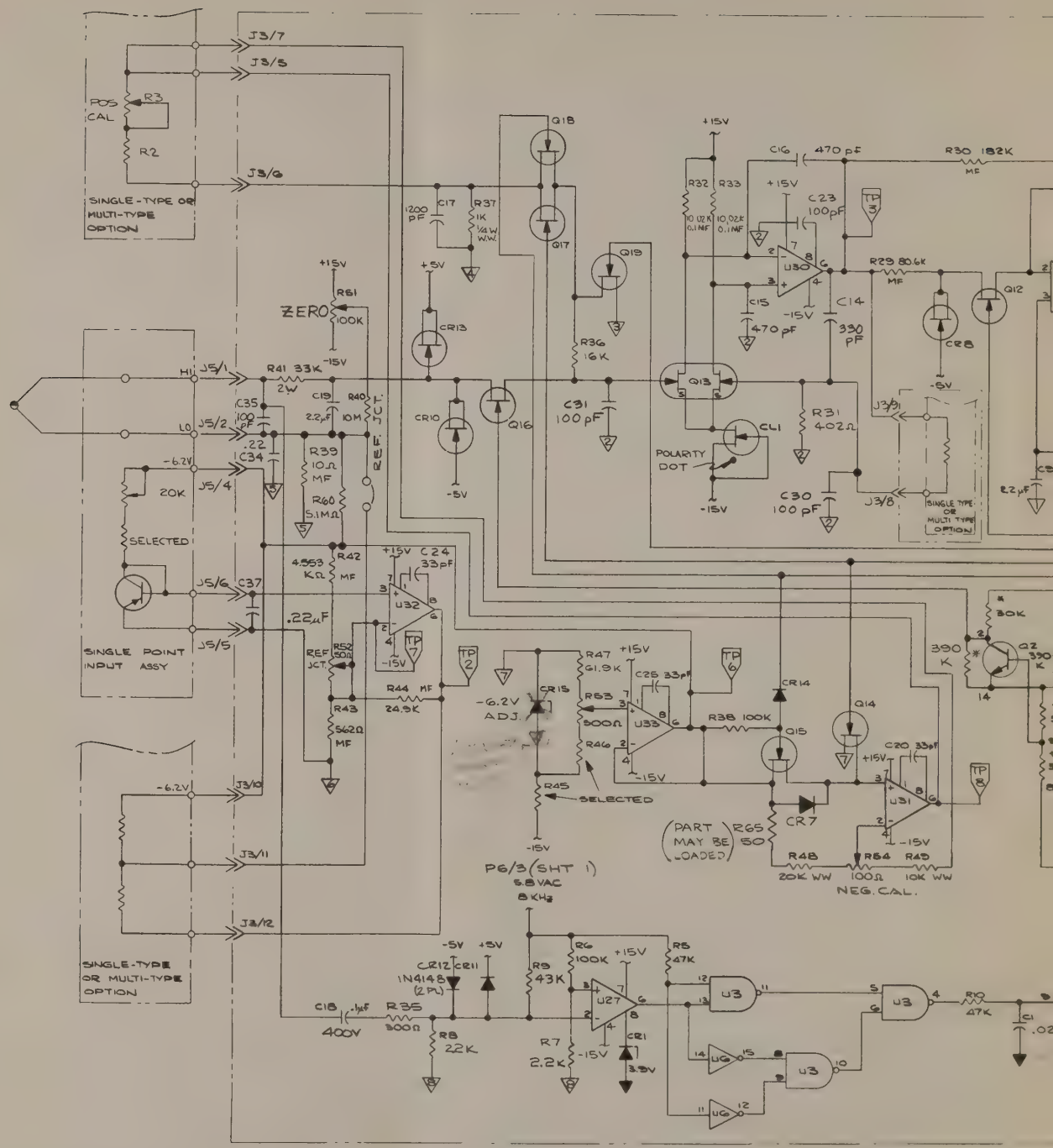

-04 AOU OPTION
LOGIC COMM
5.8V-8KHz
DE -
DE +
CL
-01 BATTERY OPTION
15VAC
15VAC
+12V
12V INPUT COMMON
POWER
LINE VOLTAGE
NC
LINE VOLTAGE
NC
GND
P11
P10
J12
DISPLAY
STROBE 6
STROBE 4
STROBE 2
STROBE 1
STROBE 3
STROBE 7
NC
B0
RB1
+180V
+5V
P6/10
-12V
DECIMAL
W
X
Y
Z
-02 DOU OPTION
J7
J8
RG
STROBE B
DECIMAL
BZ
MV-DEG. OPEN INPUT
U6/10 (SHT 2)
5.8V-8KHz
U2
CHANNEL I.D.
80
40
20
10
8
4
2
1
P1
U33/6
+5V
HI
LO
GUARD
-6.2V
CHANNEL I.D.
-10 MULTI-POINT OPTION

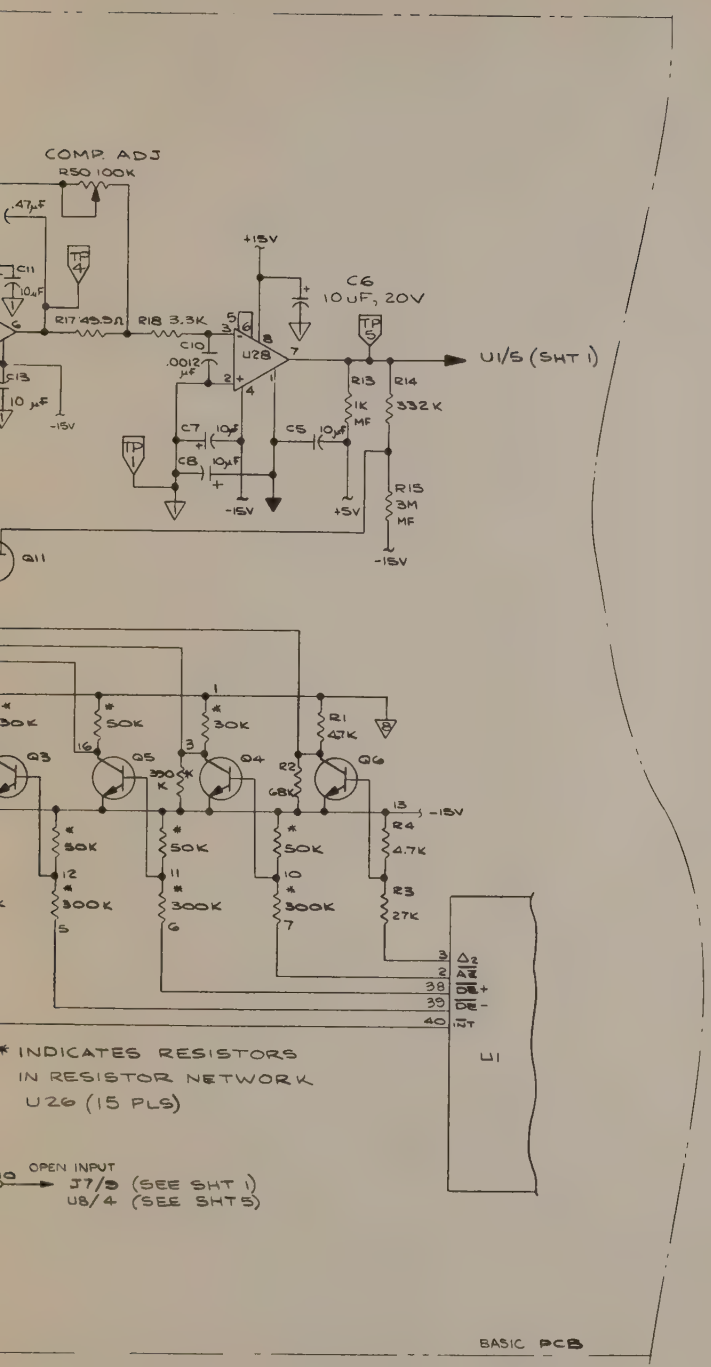


NOTES

1. SEE REF. DESIGNATOR DWG. 2100A-1601 AND PCB DWG. 2100A-4001

FIGURE 8-1. (1 of 5) BASIC INSTRUMENT SCHEMATIC

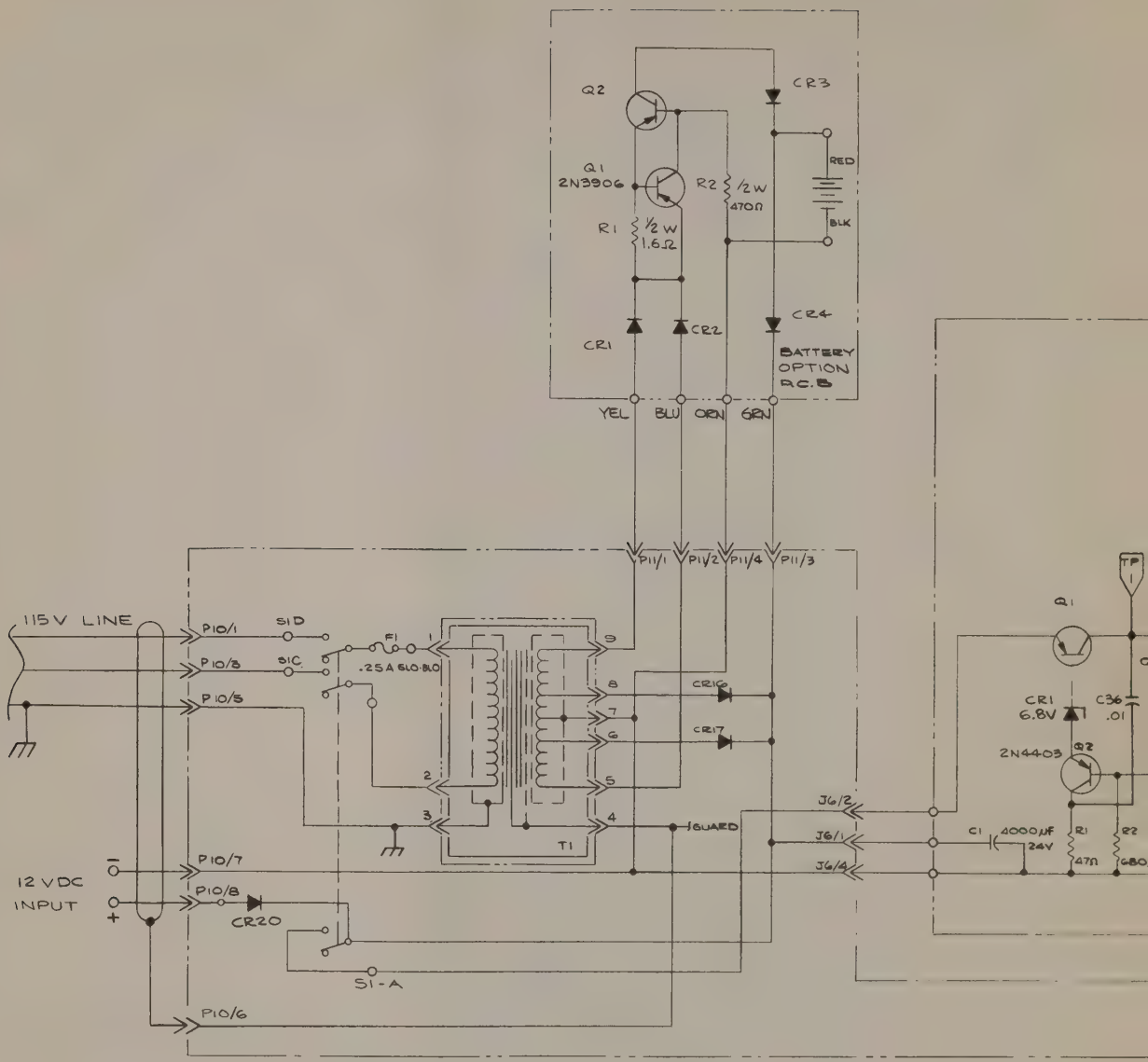

J3/7
J3/5
POS CAL
R3
R2
J3/6
SINGLE-TYPE OR MULTI-TYPE OPTION
Q18
Q17
1200 pF
C17
R37 1K 1/4 W W.W.
+15V
C16 470 pF
R30 182K MF
R32 10.02K 0.1MF
R33 10.02K 0.1MF
C23 100pF
TP 3
U30
R29 80.6K MF
C15 470 pF
C14 330 pF
-15V
Q19
+15V
R61 ZERO 100K
-15V
+5V
CR13
R36 16K
Q13
Q12
CR8
-8V
HI J5/1
LO J5/2
R41 33K 2W
C19 2.2μF
R40 10M
C35 100 pF
C22 .1
C34
-6.2V
J5/4
20K
SELECTED
R39 10Ω MF
R60 5.1MΩ
CR10
Q16
-5V
C31 100 pF
CL1
POLARITY DOT
R31 402Ω
C30 100 pF
J3/9
J3/8
SINGLE TYPE OR MULTI TYPE OPTION
2.2μF
J5/6
C37
J5/5
.22μF
SINGLE POINT INPUT ASSY
R42 4.553 KΩ MF
+15V
C24 33pF
U32
-15V
TP 7
REF JCT
R52 50Ω
R44 MF 24.9K
R43 562Ω MF
TP 2
CR15
-6.2V ADJ.
R47 61.9K
C25 33pF
R63 500Ω
U33
R46
R45 SELECTED
-15V
TP 6
CR14
R38 100K
Q15
Q14
30K
390 K
Q2
14
C20 33pF
U31
TP 8
CR7
(PART MAY BE LOADED)
R65 50
R48 20K WW
R64 100Ω
R49 10K WW
NEG. CAL.
-6.2V
J3/10
J3/11
J3/12
SINGLE-TYPE OR MULTI-TYPE OPTION
P6/3 (SHT 1)
5.8 VAC
8 KHz
-5V
+5V
CR12
CR11
1N4148 (2 PL)
R9 43K
R6 100K
+15V
U27
R5 47K
C18 .1μF 400V
R35 300Ω
R8 22K
R7 2.2K
-15V
CR1
3.9V
U3
U3
U3
U6
U6
R10 47K
C1 .02



MAIN PCB				
REF DES	+5V	+5VSW	▼	JF P.N.
U1	1		4,12,13,14,21,24,36	354985
U2,U3,U4	14		7	355198
U5,U10,U15		14	7	293043
U6,U25	16,1		8	355214
U7	14		7	340117
U9		14	7	292979
U11		14	7	292995
U12		14	7	292953
U13		14	7	292987
U14,U18		14	7	292961
U16	14		7	292979
U17	14		7	292953
U19		5	8,12	293399
U20		4,5	10	320739
U21		16	8	370692
U22		24	4	▷1
U23		14	7	293001
U24		14	7	342709

▷1 370015 -°F
370023 -°C

FIGURE 8-1. (2 of 5) BASIC INSTRUMENT SCHEMATIC


Q2
CR3
Q1
2N3906
R2
½W
470Ω
RED
BLK
R1
½W
1.6Ω
CR1
CR2
CR4
BATTERY
OPTION
P.C.B.
YEL
BLU
ORN
GRN
P11/1
P11/2
P11/4
P11/3
115V LINE
P10/1
S1D
P10/3
S1C
P10/5
F1
.25A SLO-BLO
CR16
CR17
T1
GUARD
J6/2
J6/1
J6/4
12 VDC
INPUT
P10/7
P10/8
CR20
S1-A
P10/6
TP
Q1
CR1
6.8V
C36
.01
2N4403
Q2
C1
4000μF
24V
R1
47Ω
R2
680

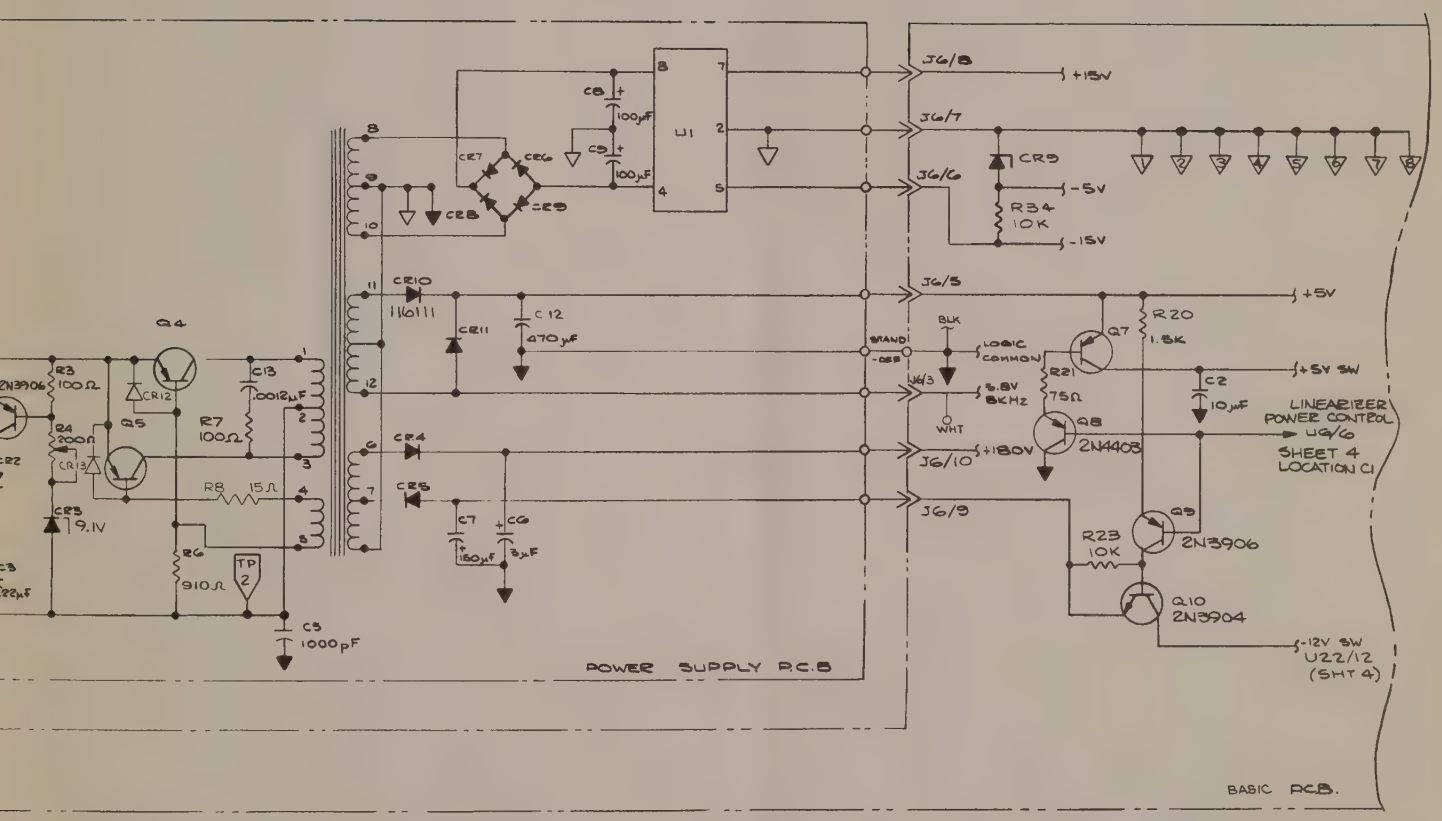
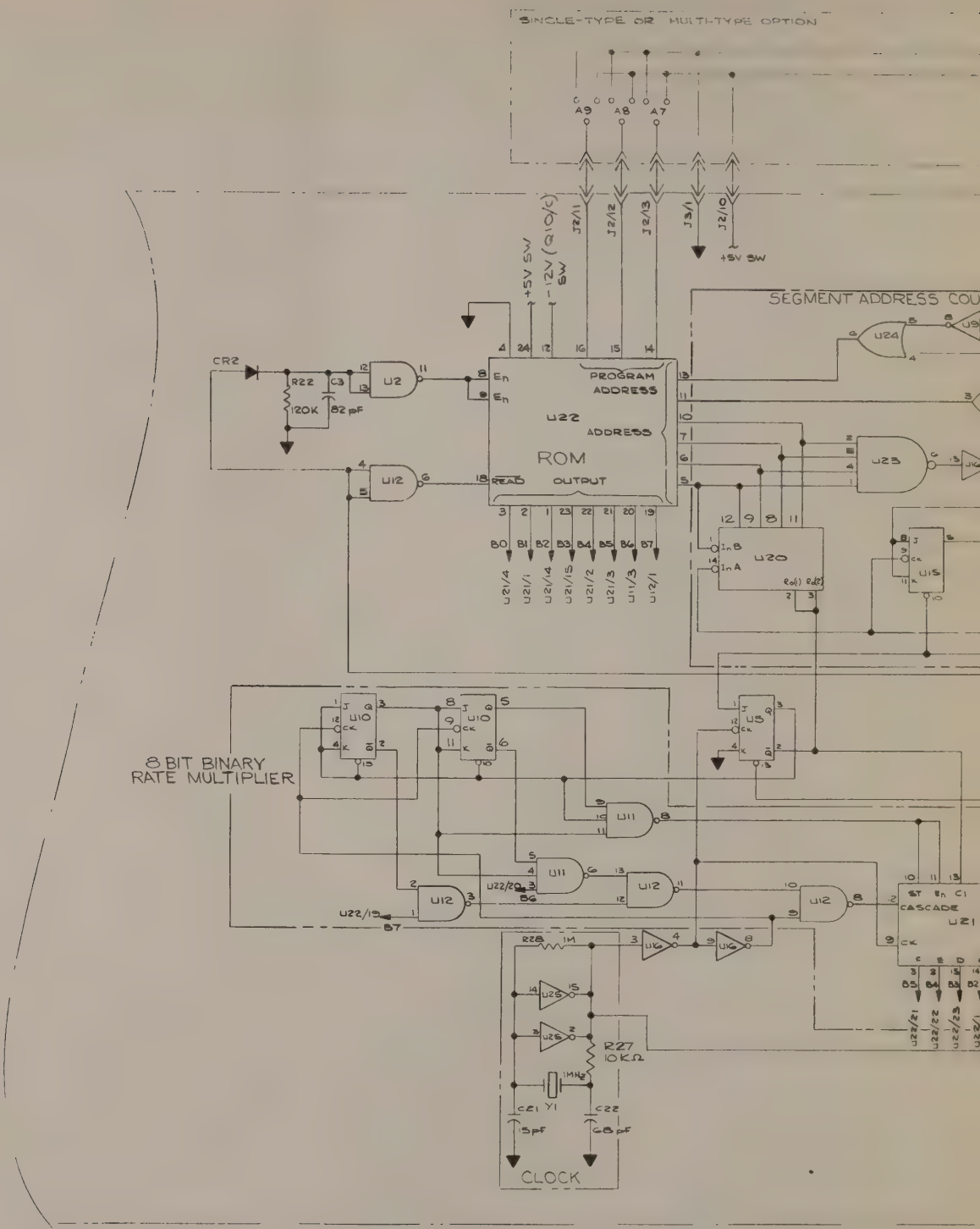


FIGURE 8-1. (3 of 5) BASIC INSTRUMENT SCHEMATIC


SINGLE-TYPE OR MULTI-TYPE OPTION
A9
A8
A7
J2/11
J2/12
J2/13
J3/1
J2/10
+5V SW
-12V (Q10/K) SW
+5V SW
SEGMENT ADDRESS COU
CR2
R22
120K
C3
82 pF
U2
U12
U22
PROGRAM ADDRESS
ADDRESS
ROM
OUTPUT
READ
U24
U23
U20
U15
B0
B1
B2
B3
B4
B5
B6
B7
U21/4
U21/1
U21/14
U21/15
U21/2
U21/3
U11/3
U12/1
8 BIT BINARY RATE MULTIPLIER
U10
U11
U12
U22/20
U22/19
B6
B7
CASCADE
U21
R28
1M
U25
U26
R27
10KΩ
1MHz
Y1
C21
3pf
C22
68 pf
CLOCK

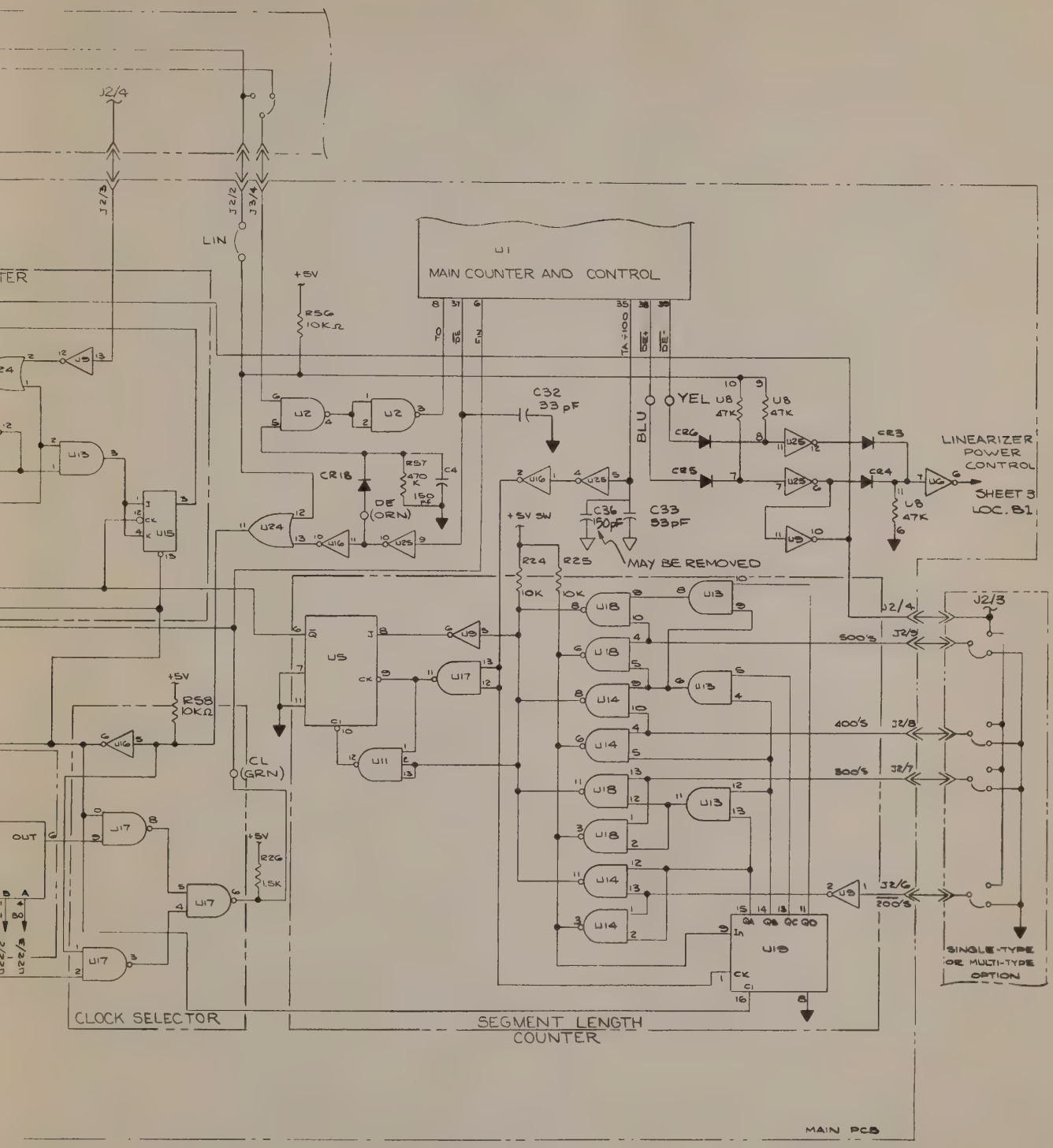
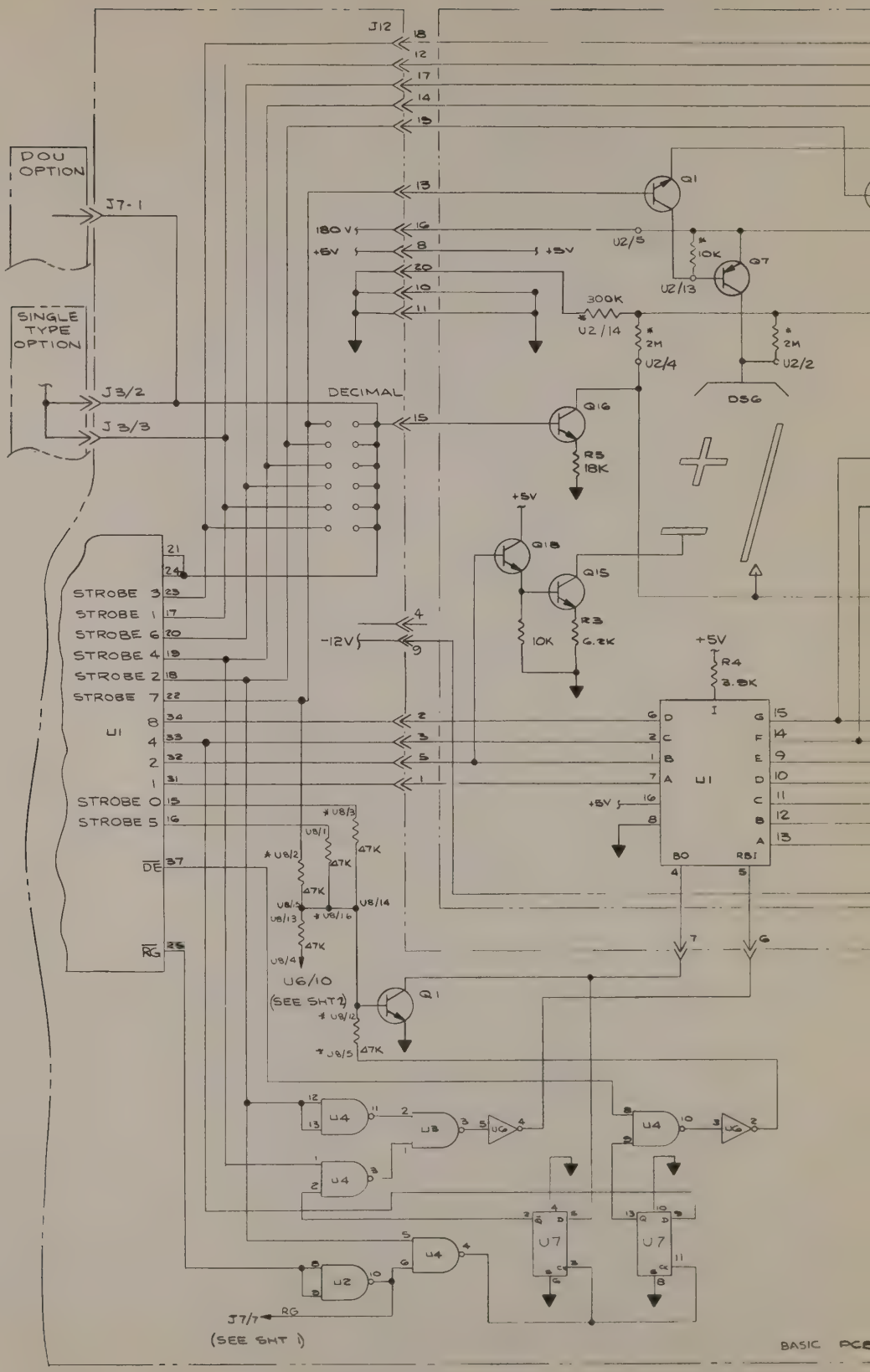
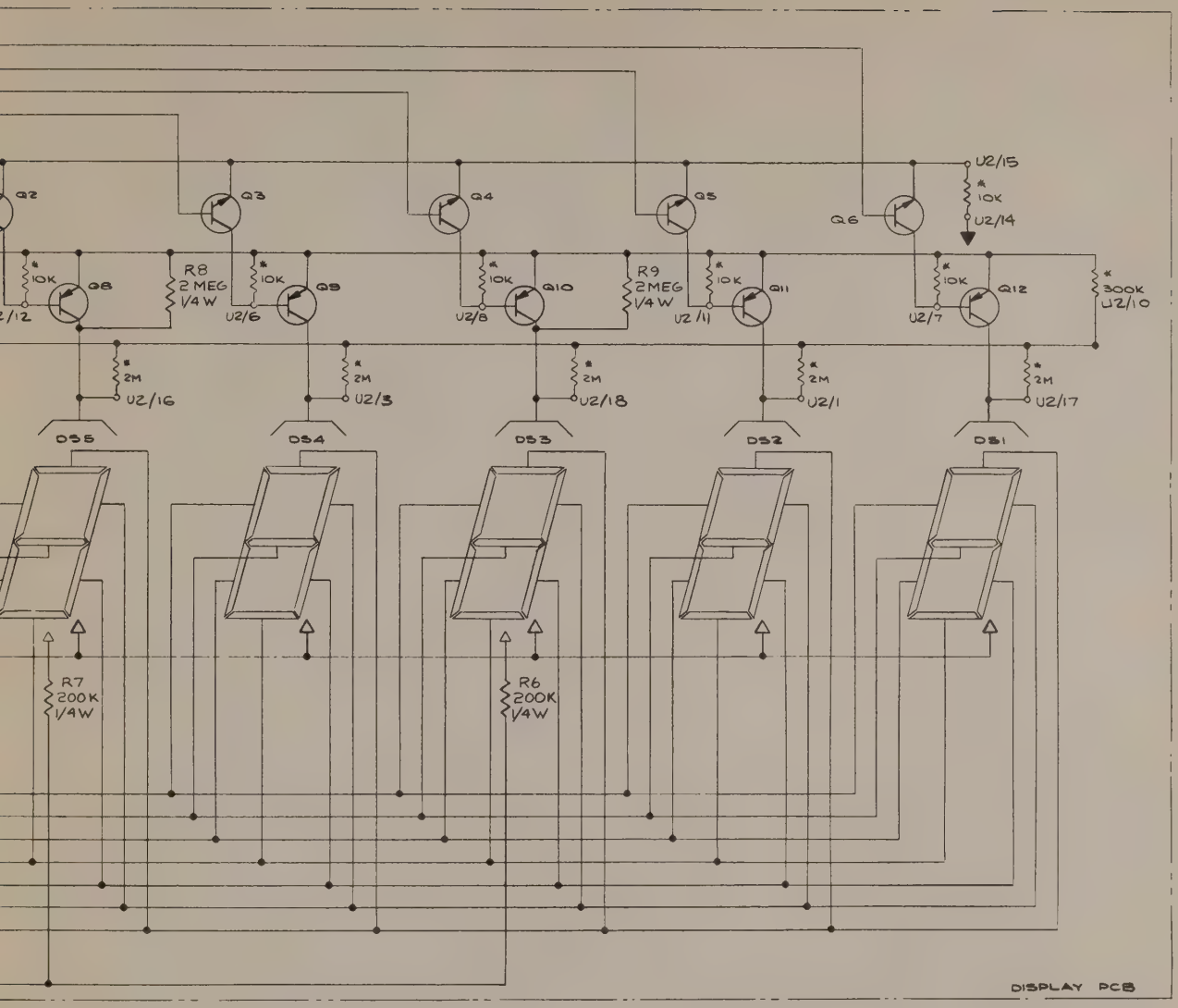


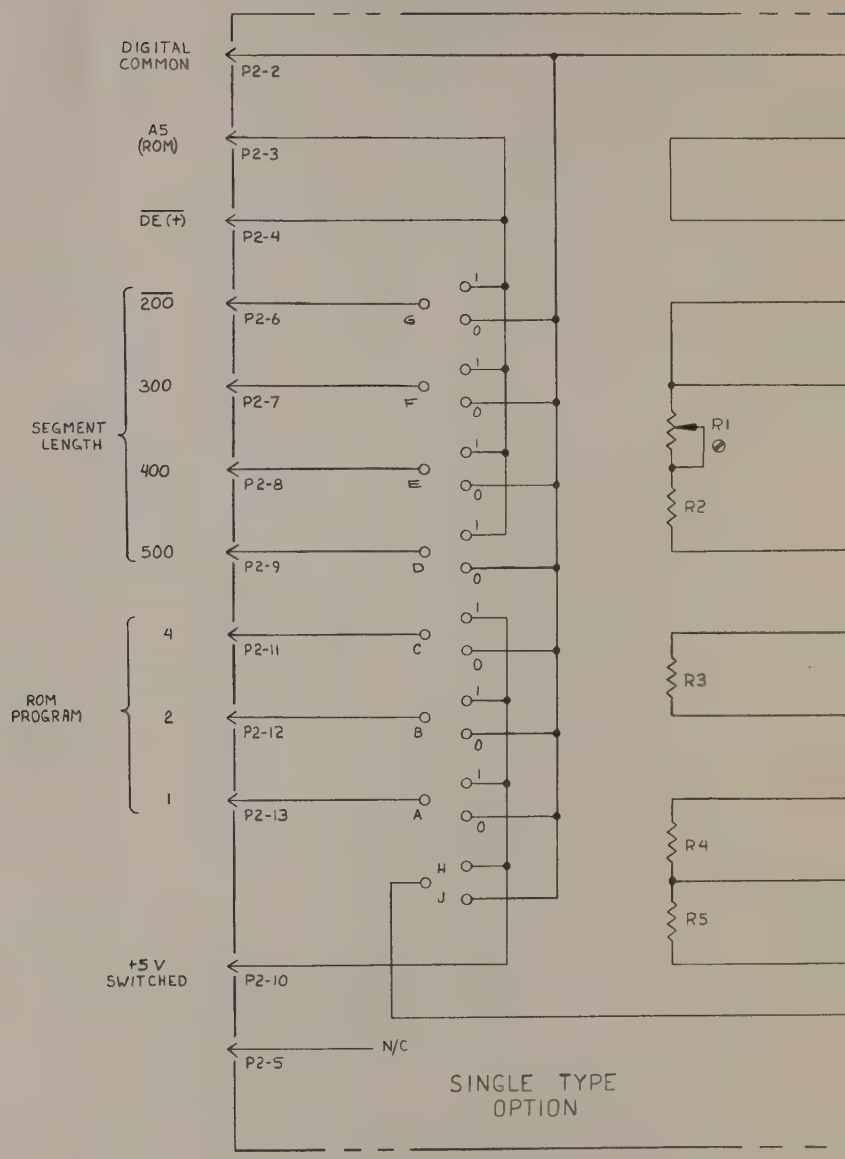
FIGURE 8-1. (4 of 5) BASIC INSTRUMENT SCHEMATIC


J12
DOU OPTION
J7-1
SINGLE TYPE OPTION
J3/2
J3/3
DECIMAL
180 V
+5V
-12V
Q1
Q7
Q16
Q18
Q15
U2/5
U2/13
U2/14
U2/4
U2/2
10K
300K
2M
R5 18K
R3 6.2K
R4 3.9K
DSG
STROBE 3
STROBE 1
STROBE 6
STROBE 4
STROBE 2
STROBE 7
STROBE 0
STROBE 5
U1
DE
RG
U6/10
(SEE SHT 7)
47K
U4
U2
U7
J7/7 RG
(SEE SHT 1)
BASIC PCB

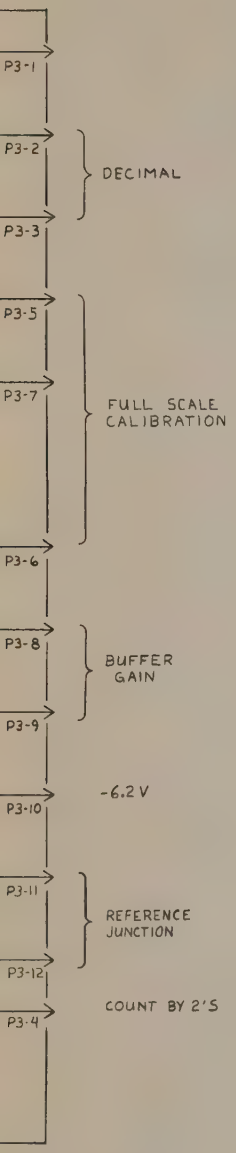


* INDICATES RESISTORS IN RESISTOR NETWORK

FIGURE 8-1. (5 of 5) BASIC INSTRUMENT SCHEMATIC


DIGITAL COMMON
P2-2
A5 (ROM)
P2-3
DE (+)
P2-4
SEGMENT LENGTH
200
300
400
500
P2-6
P2-7
P2-8
P2-9
G
F
E
D
ROM PROGRAM
4
2
1
P2-11
P2-12
P2-13
C
B
A
H
J
+5 V SWITCHED
P2-10
N/C
P2-5
R1
R2
R3
R4
R5
SINGLE TYPE OPTION

DWG. NO	THERMO-COUPLE TYPE	JUMPER POSITION								RESISTOR VALUE				
		A	B	C	D	E	F	G	H	J	R1	R2	R3	R4	R5
1211	J°F	0	0	0	0	1	0	1		X	200Ω	23.7K	14.7K	121K	23.445K
1212	K°F	1	0	0	1	0	0	1		X	200Ω	32.38K	21K	149.0K	29.931K
1210	T°F	0	1	0	0	0	0	0		X	200Ω	32.38K	21K	137.04K	29.784K
1213	E°F	1	1	0	0	1	0	1		X	200Ω	19.41K	12.4K	95.52K	19.901K
1214	R°F	0	0	1	1	0	0	1	X		1K	110.09K	71.5K	788.6K	204.5K
1215	S°F	1	0	1	1	0	0	1	X		1K	110.09K	71.5K	799.5K	202.6K
1217	J°C	0	0	0	0	0	0	0		X	100Ω	11.97K	8.06K	44.563K	23.445K
1218	K°C	1	0	0	0	1	0	1		X	100Ω	17.55K	11.5K	55.947K	29.931K
1216	T°C	0	1	0	0	0	0	0		X	100Ω	18.17K	11.5K	55.09K	29.784K
1219	E°C	1	1	0	0	0	0	0		X	100Ω	11.35K	7.68K	37.01K	19.901K
1220	R°C	0	0	1	0	0	1	1		X	1K	110.09K	71.5K	368.9K	204.5K
1221	S°C	1	0	1	0	0	1	1		X	1K	110.09K	71.5K	366.7K	202.6K



NOTES:

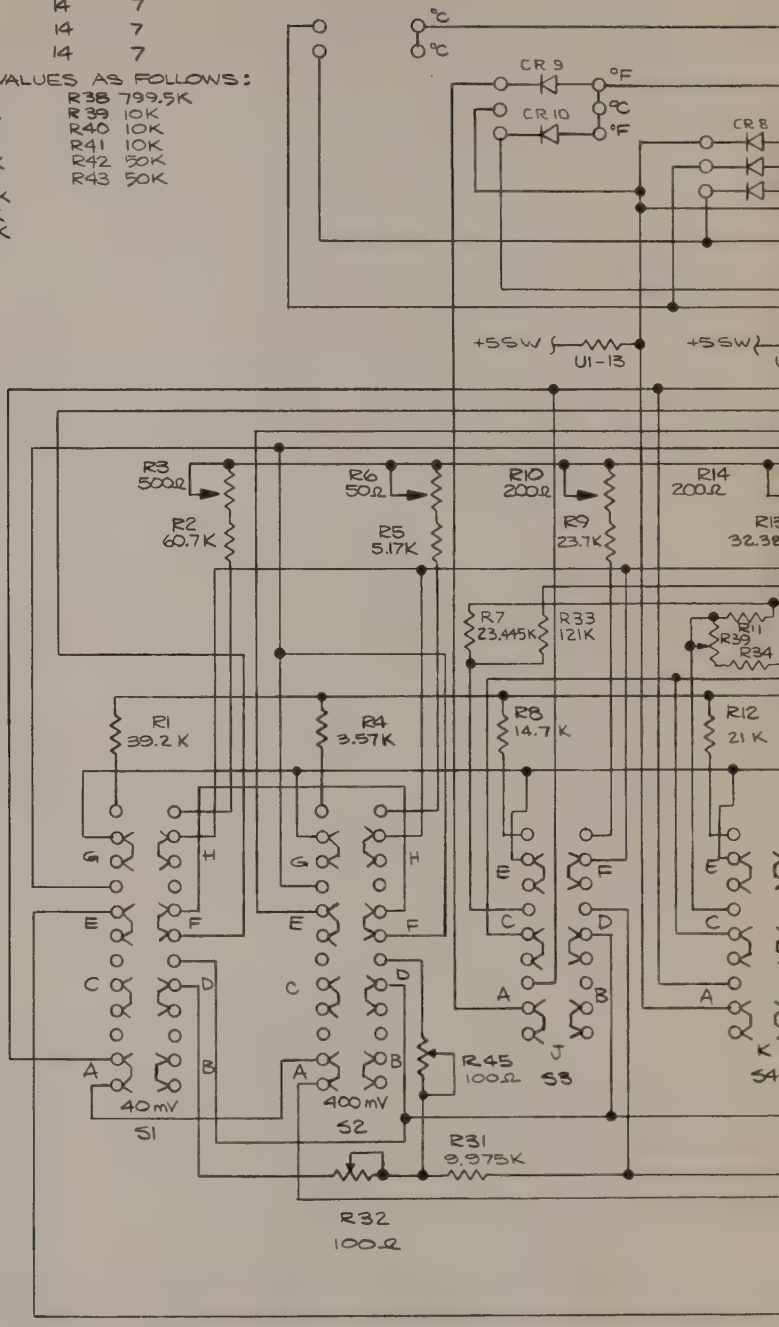
1. LETTERS "A" THRU "G" IDENTIFY DUAL POSITION JUMPERS. NUMBERS "0" AND "1" IDENTIFY JUMPER POSITIONS.
2. LETTERS "H" AND "J" IDENTIFY JUMPER POSITIONS.

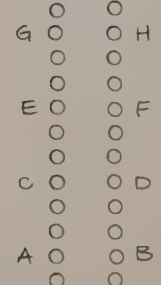
FIGURE 8-2. SINGLE TYPE PCB SCHEMATIC

		+5SW	GND
U1	10KΩ	14	7
U2	7404	14	7
U3	7402	14	7
U4	7410	14	7
U5	7400	14	7

RESISTOR VALUES AS FOLLOWS:

R11	29.93K	R38	799.5K
R15	29.784K	R39	10K
R19	19.90K	R40	10K
R23	204.5K	R41	10K
R27	202.6K	R42	50K
R34	149K	R43	50K
R35	137.04K		
R36	95.52K		
R37	788.6K		





VIEWED FROM CIRCUIT SIDE

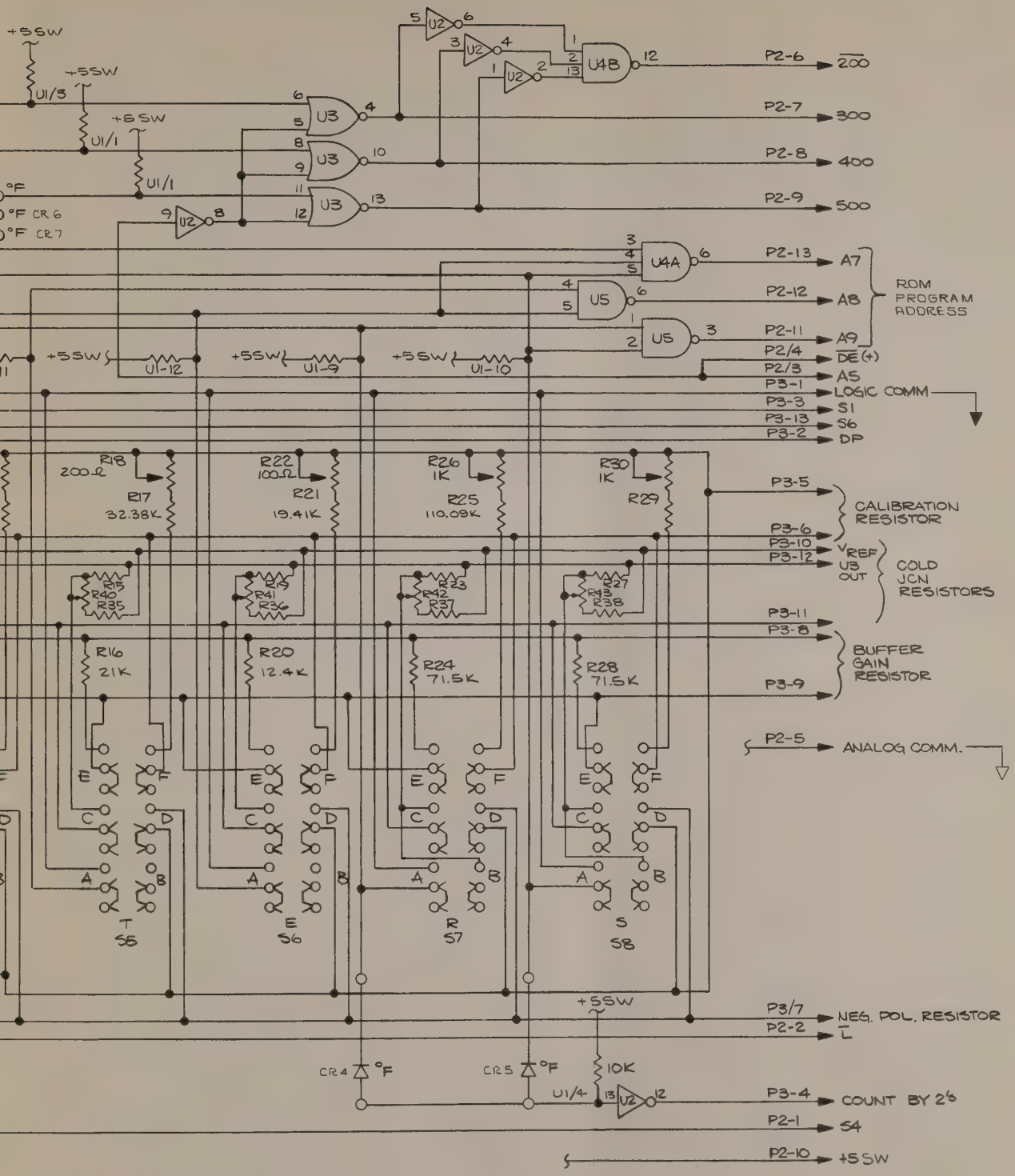
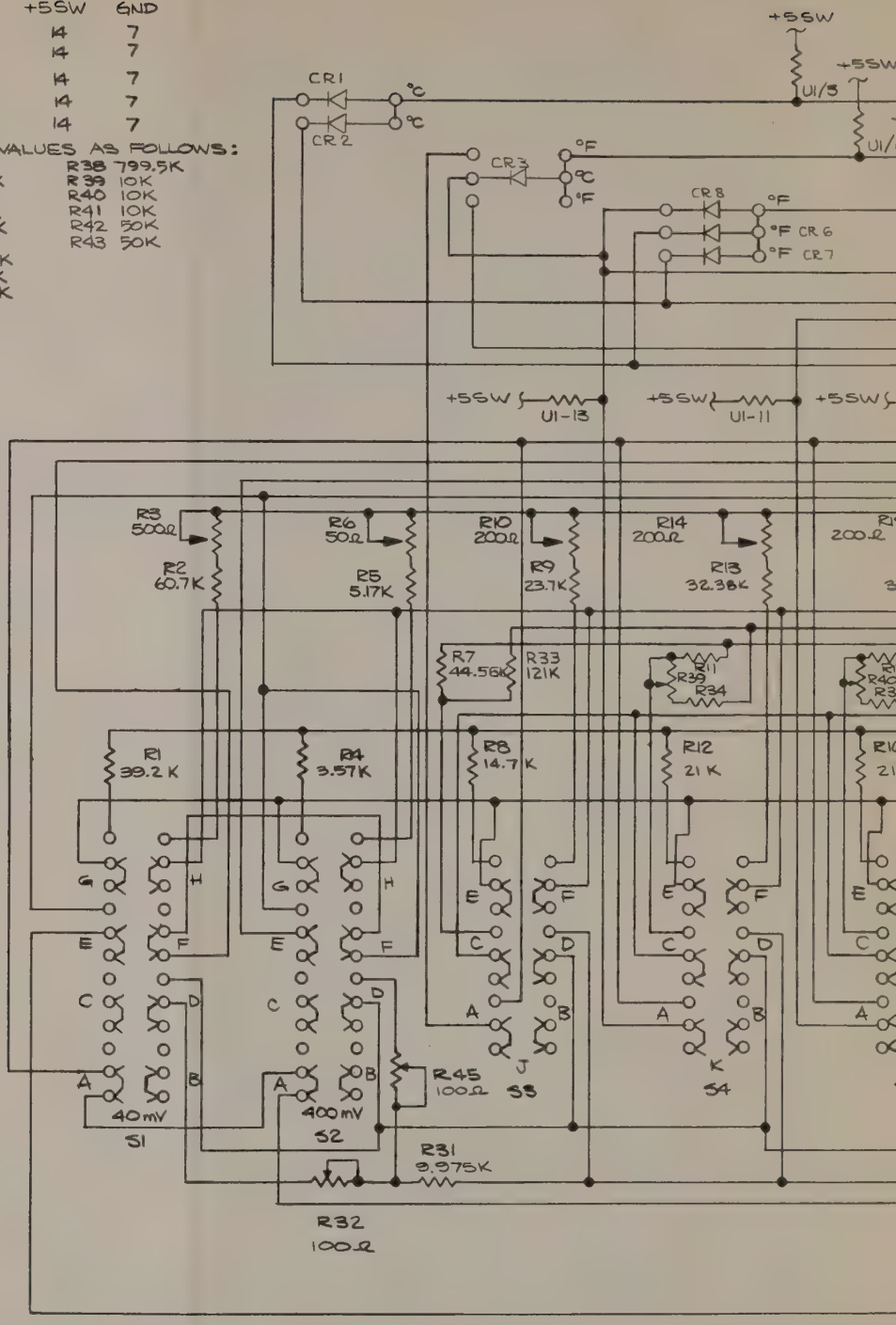


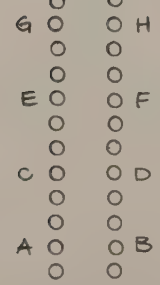
FIGURE 8-3. MULTI-TYPE PCB, °F SCHEMATIC

		+5SW	GND
U1	10KΩ	14	7
U2	7404	14	7
U3	7402	14	7
U4	7410	14	7
U5	7400	14	7

RESISTOR VALUES AS FOLLOWS:

R11	29.93K	R38	799.5K
R15	29.784K	R39	10K
R19	19.90K	R40	10K
R23	204.5K	R41	10K
R27	202.6K	R42	50K
R34	149K	R43	50K
R35	137.04K		
R36	95.52K		
R37	788.6K		





VIEWED FROM CIRCUIT SIDE

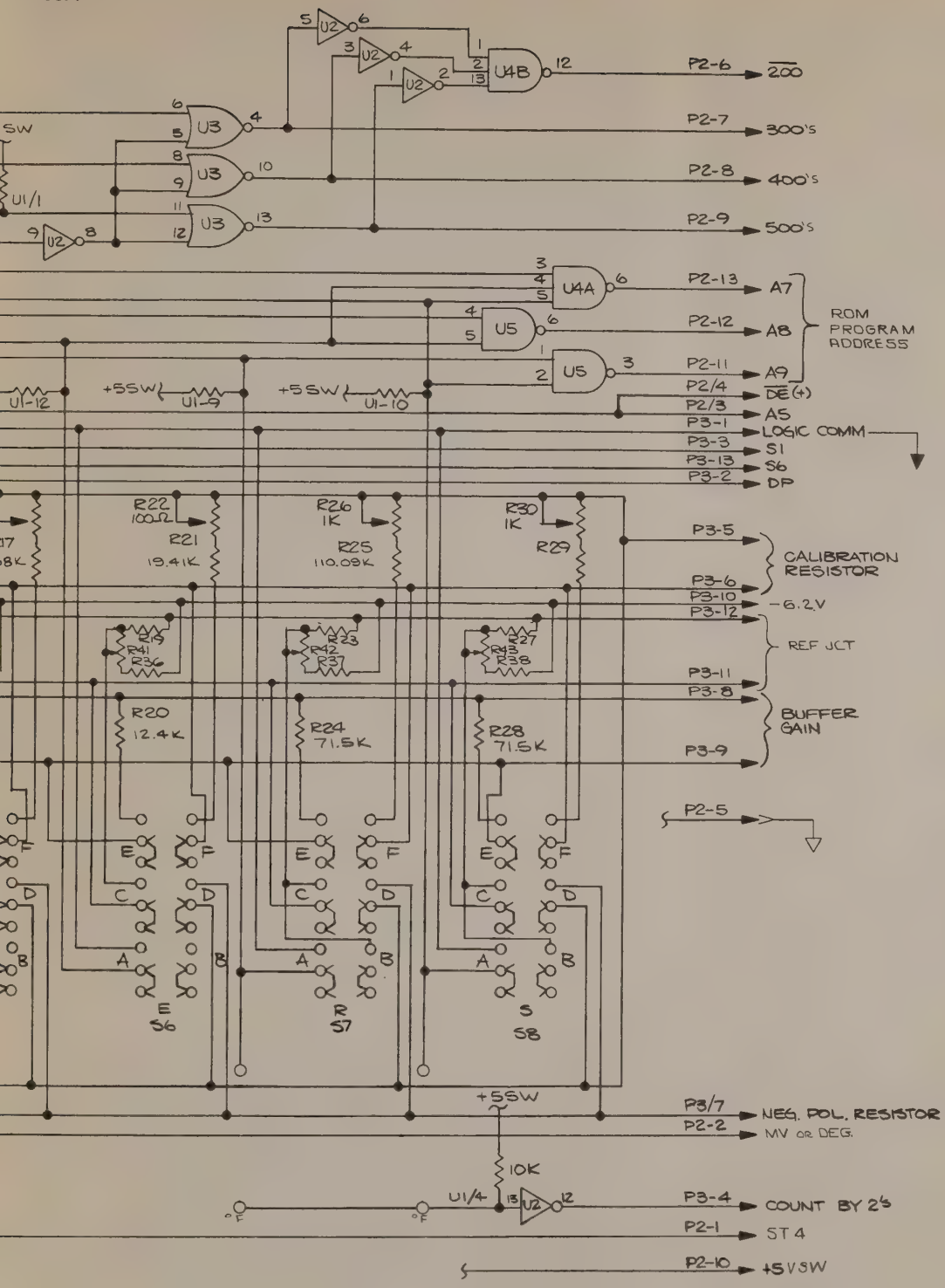
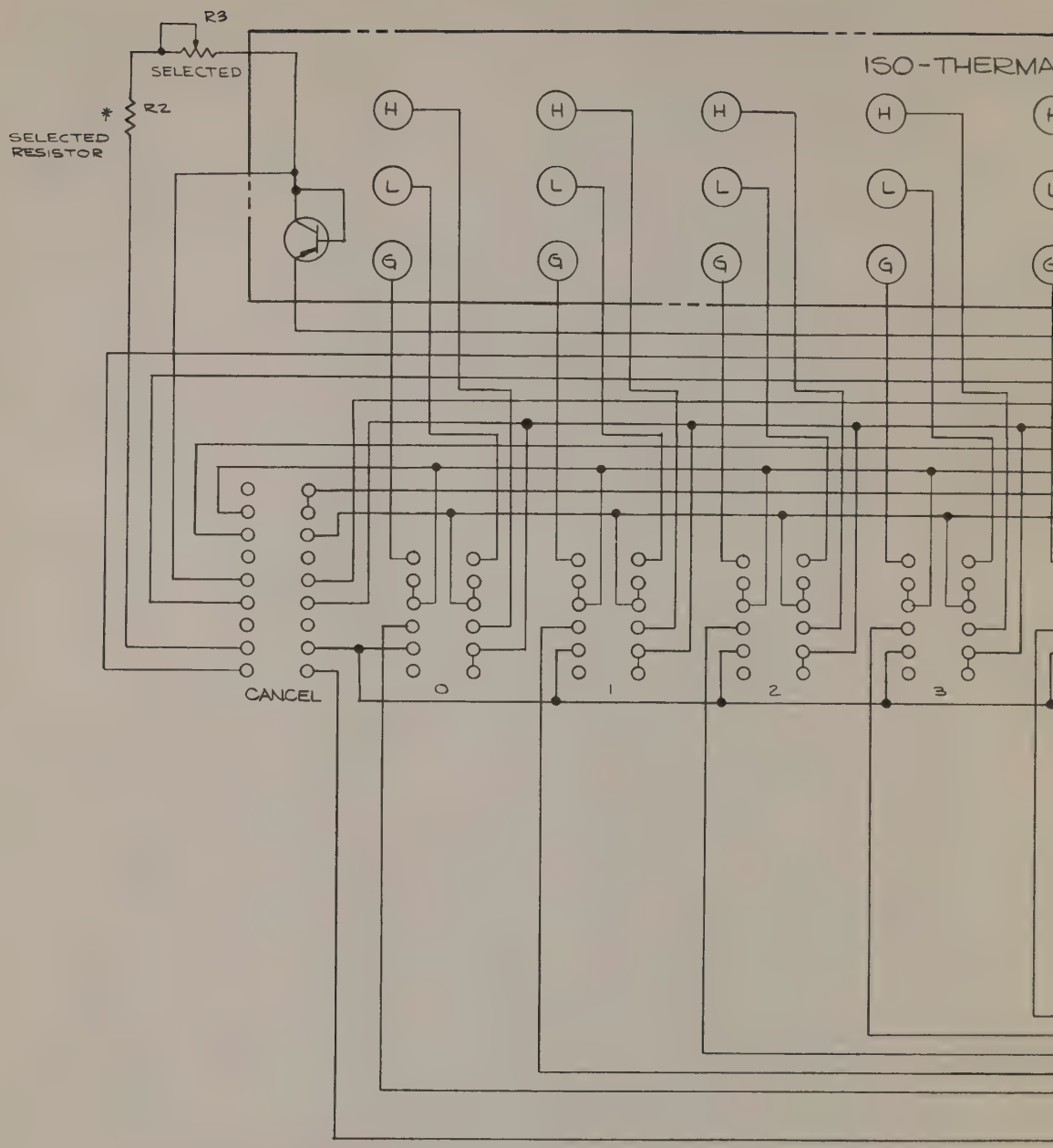


FIGURE 8-4. MULTI-TYPE PCB, °C SCHEMATIC


R3
SELECTED
*
R2
SELECTED
RESISTOR
ISO-THERMA
H
L
G
CANCEL
0
1
2
3

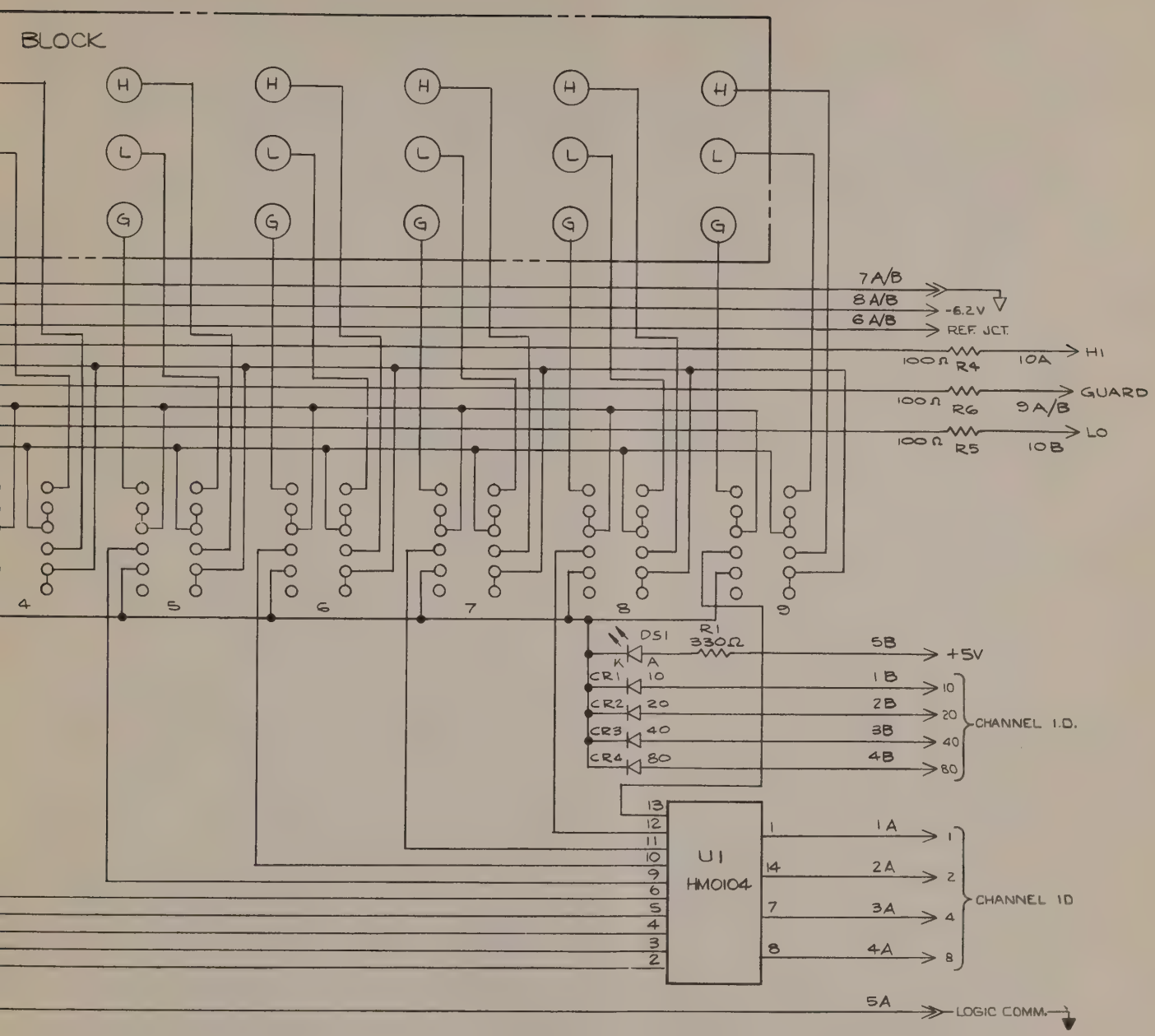
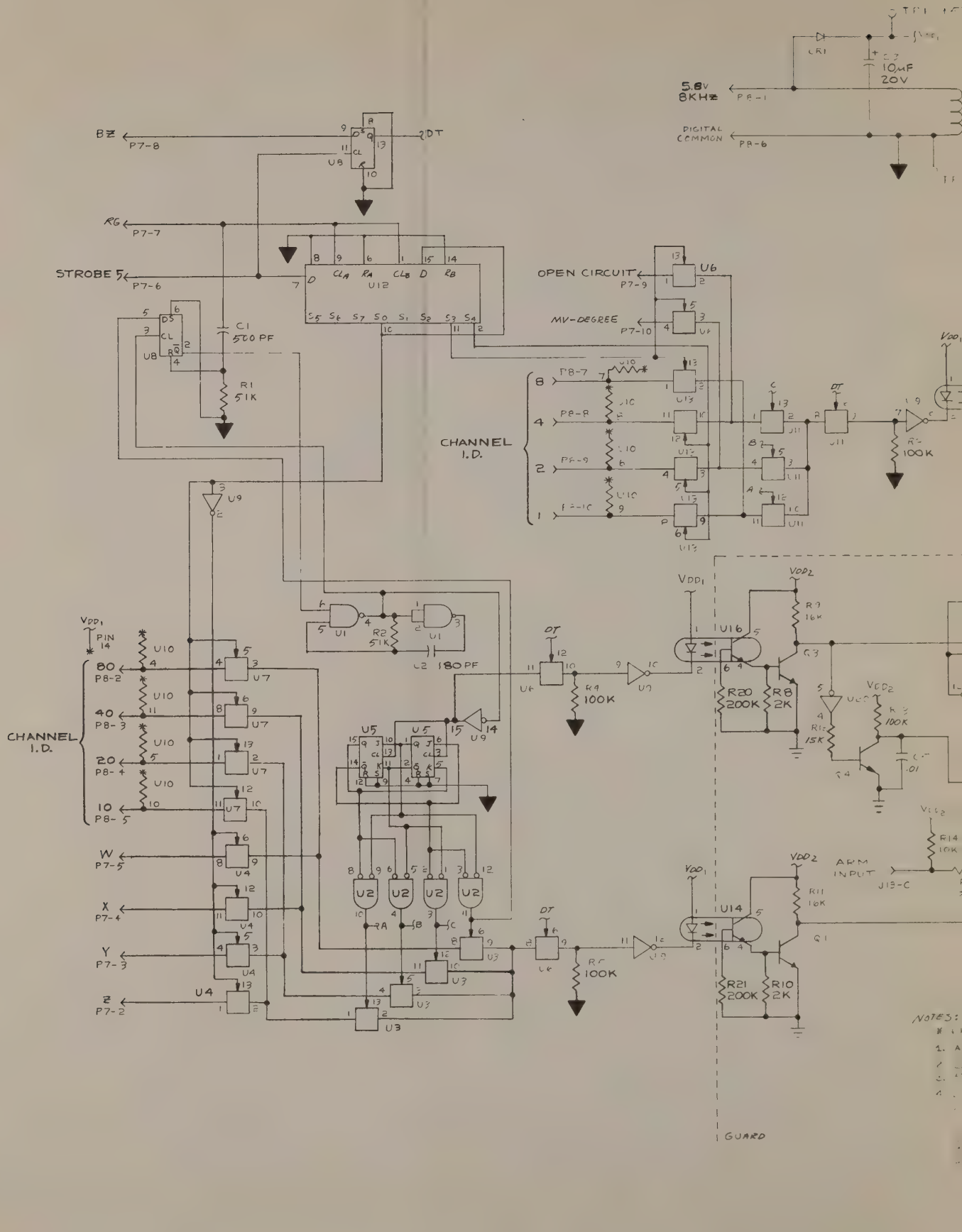


FIGURE 8-5. MULTI-POINT PCB SCHEMATIC


5.8V 8KHz
P8-1
DIGITAL COMMON
P8-6
CR1
C3 10MF 20V
BZ
P7-8
DT
U8
RG
P7-7
STROBE
P7-6
U12
C1 500 PF
R1 51K
OPEN CIRCUIT
P7-9
U6
MV-DEGREE
P7-10
CHANNEL I.D.
P8-7
P8-8
P8-9
P8-10
U10
U13
U11
R2 100K
U9
U1
R2 51K
C2 180PF
U5
R4 100K
U7
U4
U2
R7 100K
R8 2K
R20 200K
U16
Q3
R9 16K
R12 15K
Q4
C4 .01
R14 10K
ARM INPUT
J13-C
R11 16K
U14
Q1
R21 200K
R10 2K
80
P8-2
40
P8-3
20
P8-4
10
P8-5
W
P7-5
X
P7-4
Y
P7-3
Z
P7-2
PIN 14
GUARD
NOTES:

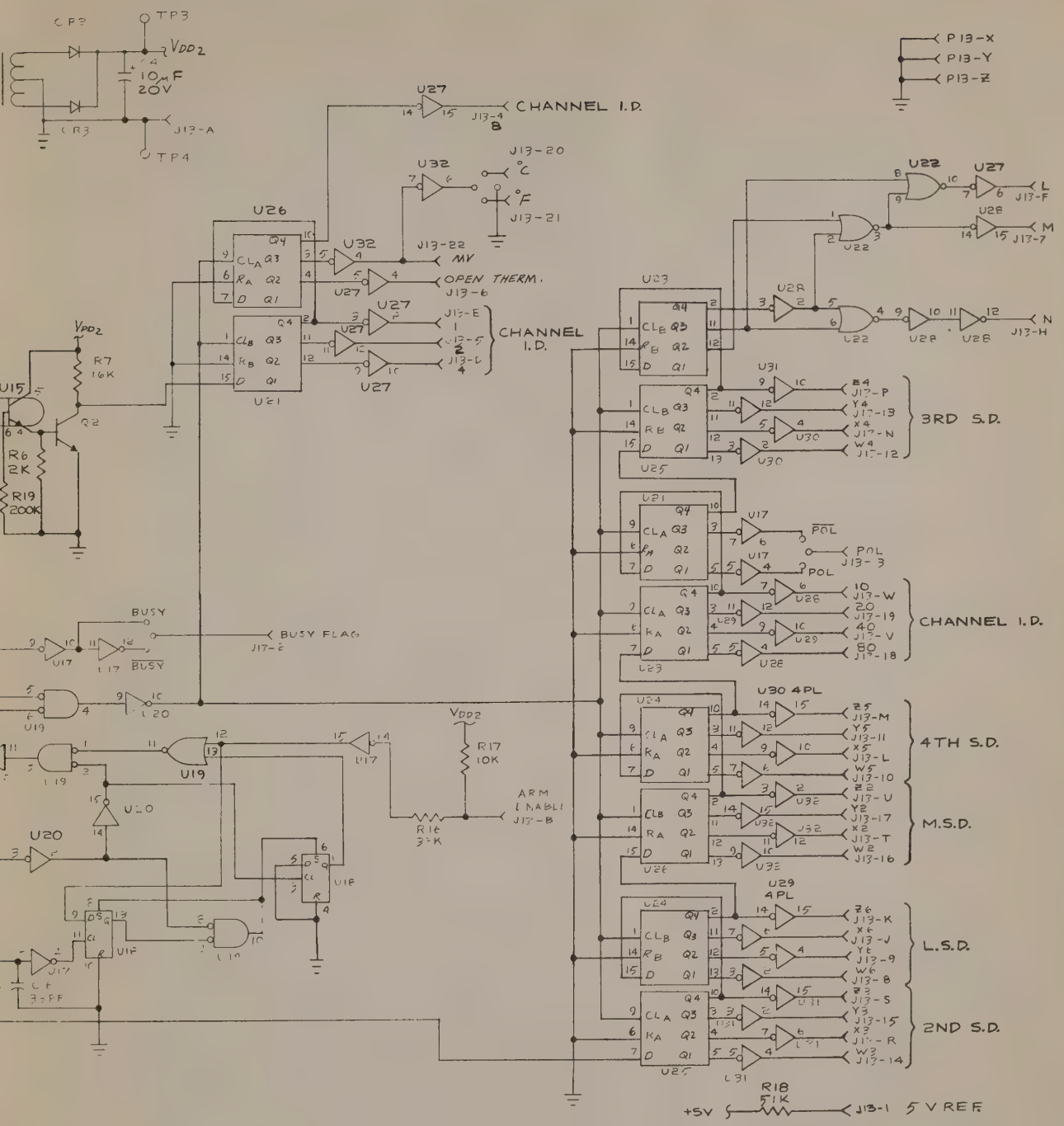
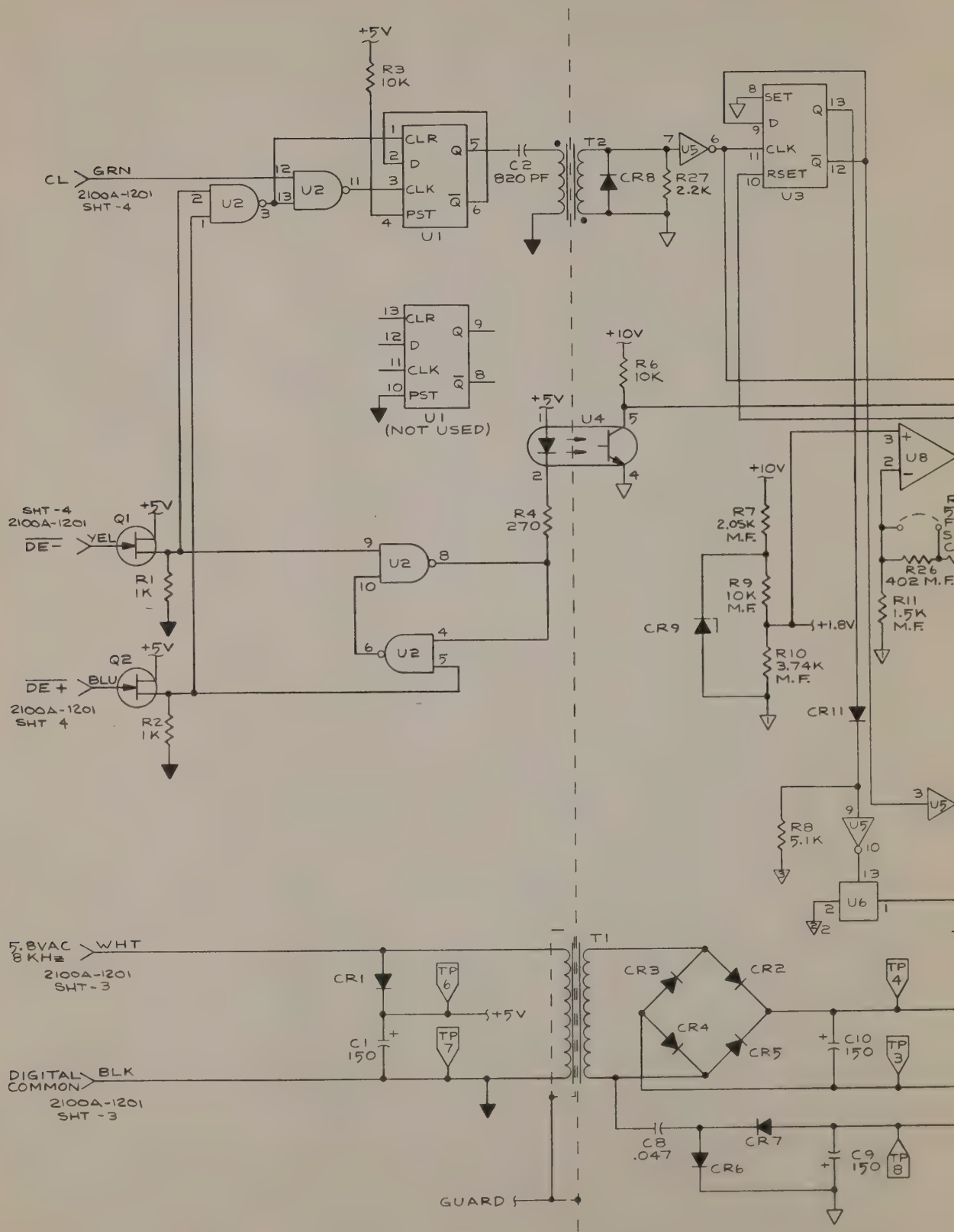
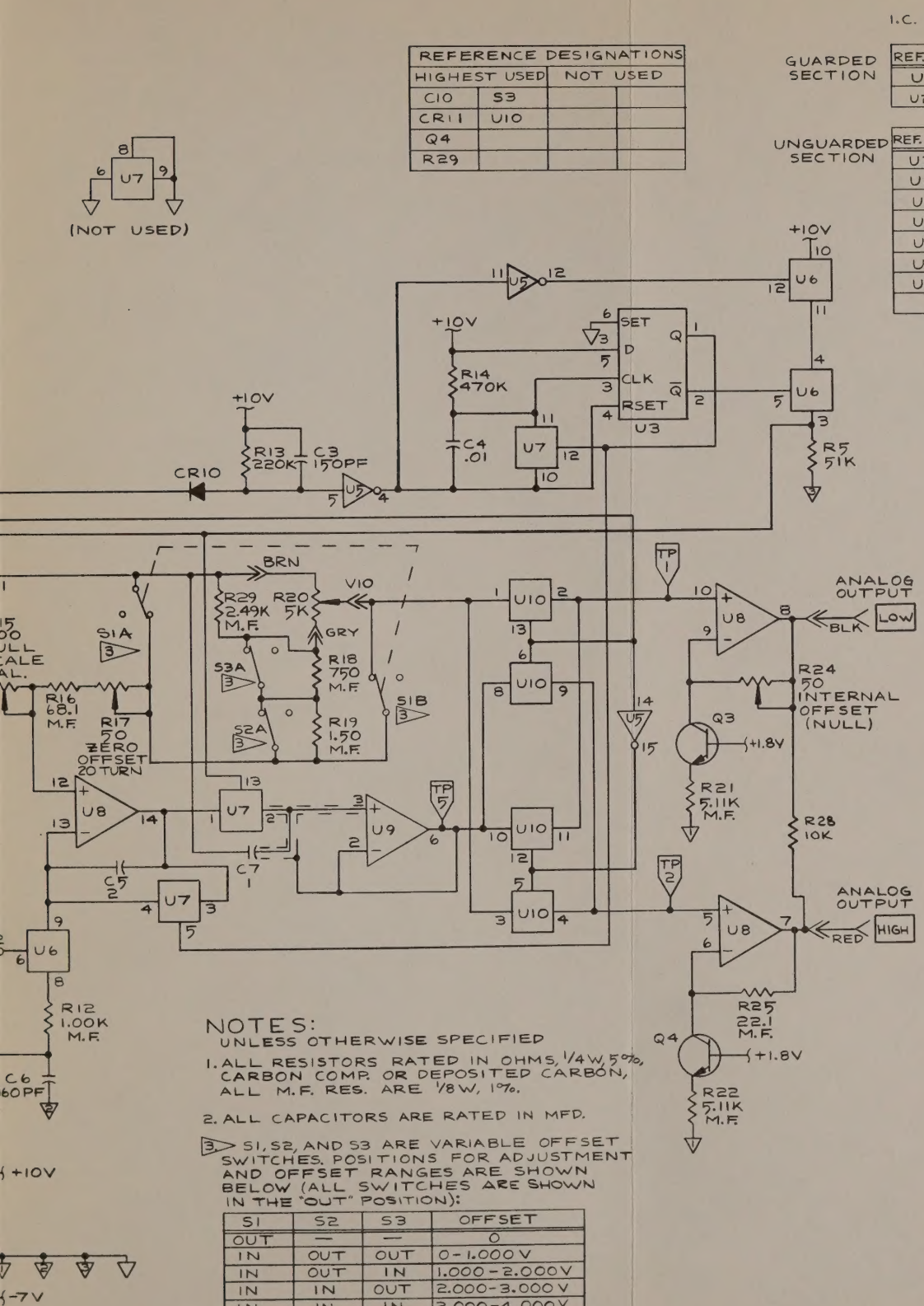


FIGURE 8-6. DATA OUTPUT UNIT SCHEMATIC


+5V
R3
10K
CL
GRN
2100A-1201
SHT-4
U2
U1
CLR
D
CLK
PST
Q
C2
820 PF
T2
CR8
R27
2.2K
U5
U3
SET
RSET
U1
(NOT USED)
+10V
R6
10K
U4
R4
270
SHT-4
2100A-1201
Q1
DE-
YEL
R1
1K
Q2
DE+
BLU
R2
1K
R7
2.05K
M.F.
R9
10K
M.F.
CR9
+1.8V
R10
3.74K
M.F.
U8
R26
402 M.F.
R11
1.5K
M.F.
CR11
R8
5.1K
U6
5.8VAC
8 KHz
WHT
DIGITAL
COMMON
BLK
T1
CR1
CR2
CR3
CR4
CR5
TP6
TP7
TP4
TP3
TP8
C1
150
C10
150
C8
.047
CR6
CR7
C9
150
GUARD



REFERENCE DESIGNATIONS			
HIGHEST USED		NOT USED	
C10	S3		
CR11	U10		
Q4			
R29			

GUARDED SECTION

REF. DES.	V_{CC} (+5V)	$-V_{CC}$ (⏚)
U1	14	7
U2	14	7

UNGUARDED SECTION

REF. DES.	V_{DD} (+10V)	V_{SS} (⏚)	$-V_{CC}$ (-7V)
U3	14	7	——
U5	1	8	——
U6	14	7	——
U7	14	7	——
U8	4	11	——
U9	7	——	4
U10	14	7	——

NOTES:
UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS RATED IN OHMS, 1/4 W, 5%, CARBON COMP. OR DEPOSITED CARBON, ALL M.F. RES. ARE 1/8 W, 1%.
2. ALL CAPACITORS ARE RATED IN MFD.
3. S1, S2, AND S3 ARE VARIABLE OFFSET SWITCHES. POSITIONS FOR ADJUSTMENT AND OFFSET RANGES ARE SHOWN BELOW (ALL SWITCHES ARE SHOWN IN THE "OUT" POSITION):

S1	S2	S3	OFFSET
OUT	—	—	0
IN	OUT	OUT	0 - 1.000 V
IN	OUT	IN	1.000 - 2.000 V
IN	IN	OUT	2.000 - 3.000 V
IN	IN	IN	3.000 - 4.000 V

FIGURE 8-7. ANALOG OUTPUT UNIT, OPTION -04) (2100A-1226)

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